Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

AUGUST ★ 1950

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

Page 119—Journal Section of the American Society of Heating and Ventilating Engineers

Many compressed air uses in piping work . . . . see page 107

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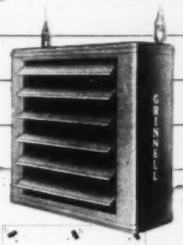
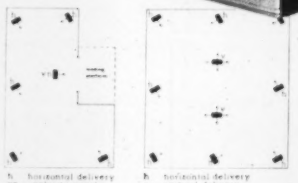
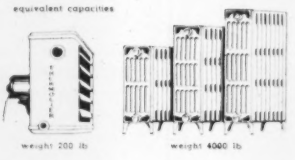
Consider the advantages of UNIT HEATING



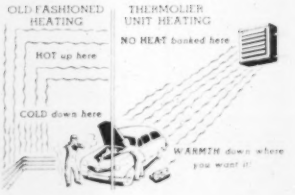


Heating comfort Unit heaters provide quick heating from a cold start. Desired temperatures are easily maintained within a close range. Heat is uniformly distributed in the working zone by forced air circulation. It is a very flexible system because different or changing heating requirements are easily satisfied by means of different models, a range of capacities, single- or two-speed motors and individual thermostatic controls.

Low first cost Unit heaters are so efficient and so compact that their heating capacity is often equivalent to the capacity of cast iron radiation or pipe coils of twice the cost. Additional savings are effected because the system requires a proportionately smaller amount of pipe, fittings and accessories.



Economy of operation Heat is forced down to the working level . . . not banked uselessly at the ceiling level. Heat is turned on and off merely by throwing a switch either manually or automatically by simple thermostatic controls. The rapid response means that heat is furnished only when and where it is wanted . . . no heat is wasted.



Adaptability to equipment and floor layout Unit heating is widely used in industrial plants and warehouses, garages, stores and public buildings. The units and the simple piping are overhead where they do not interfere with arrangement of operating machinery or equipment and do not take up valuable floor or wall space. Units are easily relocated at any time to meet changes in layout.

Thermolier unit heaters have important construction advantages The design of Thermolier unit heaters is the product of Grinnell Company's ninety-nine years of heating experience. Those responsible for heating like Thermolier's durability, freedom from maintenance troubles and dependable operation. Typical of its construction features is the patented internal cooling leg which permits the use of a plain thermostatic trap, the simplest, least expensive kind of trap. Other features are built-in drainage, continuous rated capacity and provision for expansion of U-tubes.

GRINNELL

Thermolier unit heaters

Grinnell Company, Inc. Providence R. I. Branches: Atlanta • Billings • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

Puzzle: *find the air conditioning unit*

It's there, all right . . . but it's so compact, so inconspicuous, that it takes a sharp-eyed guest to find it. But that's only one of the things that pleased the management of the famed Chase Hotel in St. Louis . . . when they completely air conditioned with USAIRco Modu-aires.

What really got them excited was that all the hundreds of Modu-aire units went in without an inch of expensive ductwork! There was no wholesale ripping out of walls or partitions . . . no valuable space wasted on huge supply ducts. Rentable guest rooms were out of service only three or four at a time . . . and only for a day or two at the most . . .

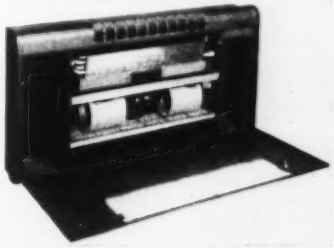
And get this! Every guest at the Chase controls his own weather, twists a tiny dial to make his room as cool as he likes it summer . . . as warm as he wishes in winter. Yes, these year 'round Modu-aire units do both jobs!

Modu-aire is the one ideal answer to the puzzler of air conditioning existing buildings. The system is simply a series of small, powerful air conditioning plants connected to a central coolant source.

They cool with chilled water from a well or cooling machine or with Freon. They heat with steam or heated water. Units may be recessed beneath windows (as at the Chase) or may be freestanding models.

Next time you tackle a hotel, or any multi-room building, take a close look at Modu-aire, the pioneer multi-unit air conditioning system.

St. Louis' famous Chase Hotel is in the heart of the city's most beautiful park system . . . near the finest shopping district and residential area.



Modu-aire is the smallest unit of its type . . . yet it contains larger blower for quieter operation . . . has more working room for easier installation.

USAIRco

UNITED STATES AIR CONDITIONING CORPORATION
COMO AVENUE S. E. AT 33RD, MINNEAPOLIS 14, MINNESOTA

This
"Largest of its kind"
AIR CONDITIONING SYSTEM
checks corrosion with

BYERS WROUGHT IRON PIPE

Said to be the largest job of its kind, and one of the largest office building installations in the country, the air conditioning in this Oklahoma City building is safeguarded against corrosion by Byers Wrought Iron pipe.

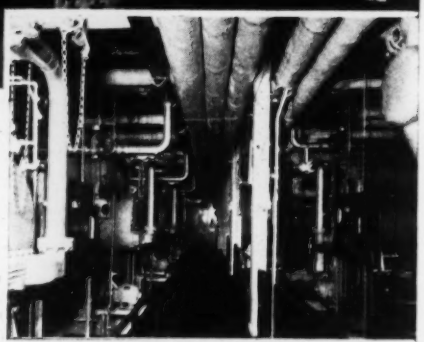
Chilled water lines, recirculating water lines, and condensed water lines all utilize this time-proven material. This 1350-ton absorption-type refrigeration equipment is located in a pent-house on the 14th floor roof of one of the wings. Chilled water lines are carried on bridges across areaways. Design contemplates the use of 45°F. water.

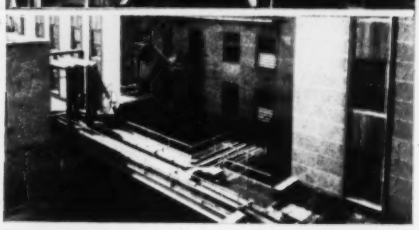
The Southwest has been a leader in the use of air conditioning equipment, and it is interesting to note how widely engineers have forestalled corrosive attack by using Byers Wrought Iron. Since the cost of even minor repairs is bound to be high, this use of wrought iron is a definite economy measure.

Wrought iron owes its ability to combat corrosion to its unusual composition and structure. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, act like a series of baffles, to halt and disperse corrosive attack. The fibers also anchor the initial protective scale, which shields the underlying metal. In cases where galvanizing is used, the naturally rougher surface of wrought iron takes and retains a heavier coating of spelter.

With air conditioning becoming a "must" in new office building construction in many sections, you may be interested in the information contained in our bulletin WROUGHT IRON FOR REFRIGERATION AND AIR CONDITIONING INSTALLATIONS. We will be glad to send you a copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, San Francisco. Export Division: New York, N. Y.





CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Heating Piping & Air Conditioning

(with which is merged the Aerologist)

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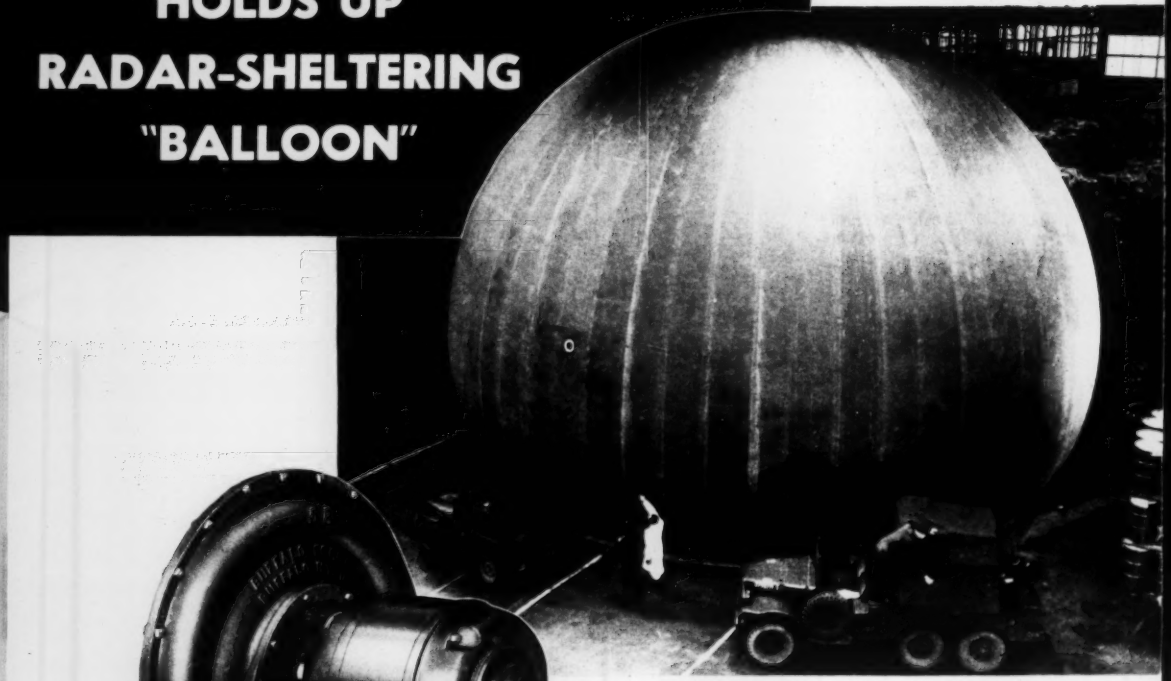
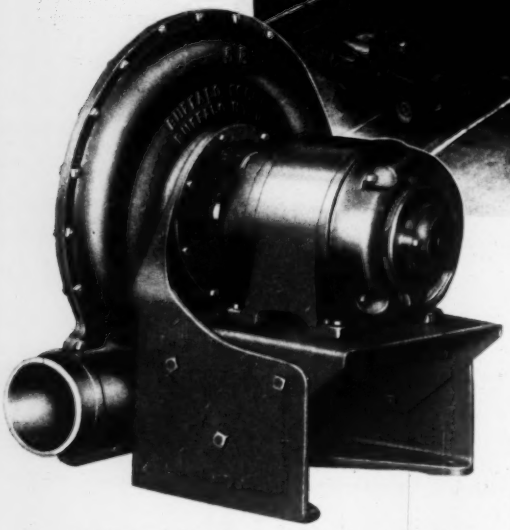
AIR BY "Buffalo"

HOLDS UP RADAR-SHELTERING "BALLOON"





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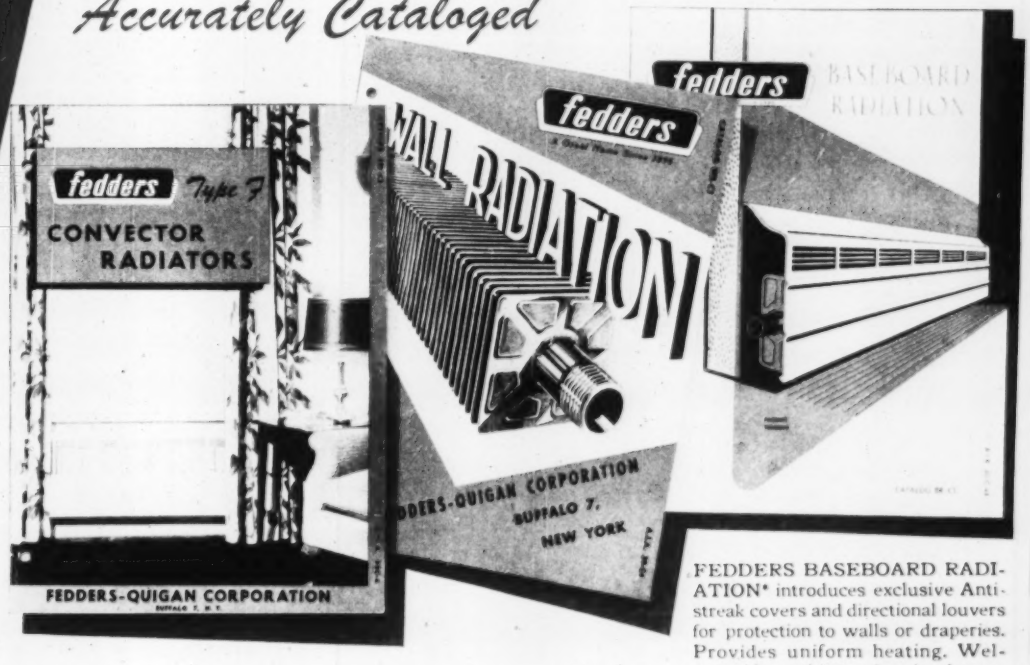

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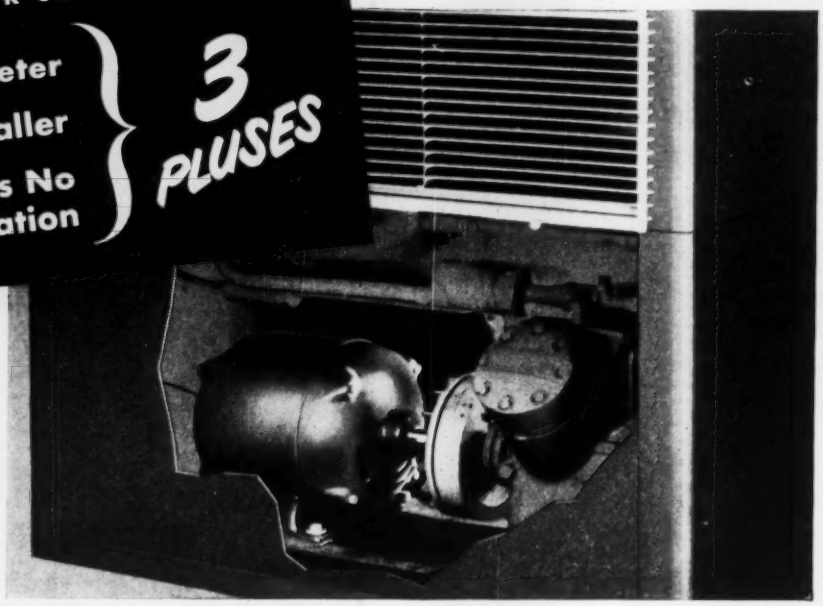
3 PLUSES



Only Life-Line offers ALL THREE

Air conditioning equipment should be "felt", not "heard". That's where Life-Line offers builders and users of air conditioning and refrigeration equipment an important advantage.

Ventilating design—the maintenance of exact air gap . . . proper cooling and winding distribution—limit "windage" noise. Dynetric balancing assures absolute smoothness. New manufacturing techniques provide micrometer alignment. Result? A minimum of noise-producing vibration. In fact, you can edge-balance a coin on a Life-Line through a start, run, stop cycle. It's *that* smooth running.

Quietness is but one feature; compactness, another. Life-Line's $\frac{1}{3}$ smaller size (over conventional-type motors) is a valuable asset when design allows only limited space. Too, Life-Line needs no lubrication. Install it in "hard-to-get-at" locations . . . crowd it into cramped quarters—and forget it!

Only Life-Line offers all three—quietness, compactness, and lubrication freedom. Why not put them to work? A phone call to your nearby Westinghouse representative will bring you complete details. Contact him now, or write Westinghouse Electric Corporation, P. O. Box, 868, Pittsburgh 30, Penna. J-21578

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Leading name in RADIANT HEAT

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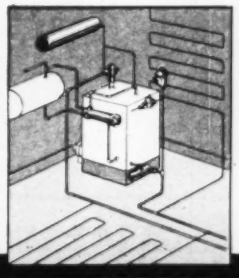
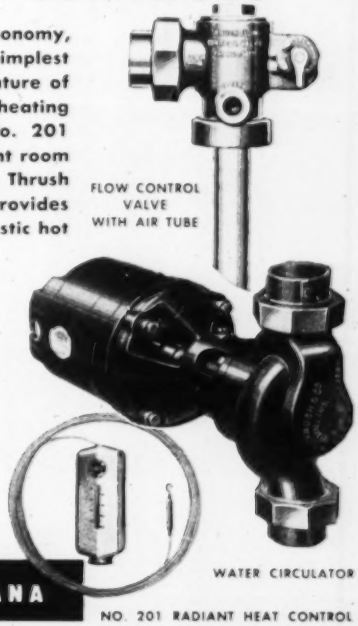
THRUSH Radiant Hot Water Heat is a leader . . . in economy, in efficiency, in popularity. Thrush Flow Control System offers the simplest yet most satisfactory method of automatically controlling temperature of radiant ceiling, wall or floor panels. This system provides uniform heating comfort without continuous Circulator operation. Inexpensive No. 201 Thrush Radiant Heat Control, illustrated below, maintains a constant room temperature and system water temperature without variation. Thrush Forced Circulating Flow Control System is easy to install. It provides economical heating plus summer as well as winter supply of domestic hot water for laundry, bath and kitchen use.



THRUSH FLOW CONTROL SYSTEM OF HOT WATER HEAT

Send for booklet giving the complete story of Thrush Radiant Hot Water Heat. The same simple equipment may be used for zoning apartments inexpensively and is ideal for modernizing home heating plants. Ask your wholesaler about it or write Dept. E-8.



FLOW CONTROL VALVE WITH AIR TUBE

WATER CIRCULATOR

NO. 201 RADIANT HEAT CONTROL

H. A. THRUSH & COMPANY • PERU, INDIANA

WORTHINGTON AIR CONDITIONING REPORT

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY

Specialists in air conditioning and refrigeration for more than 50 years

We're Part of the HOSPITALITY at the Westward Ho

If ever the name of a hotel suggested an invigorating atmosphere, it's the spectacular Westward Ho in Phoenix.

Internationally famous as a resort hotel, the Westward Ho gives its guests the year-'round comfort of air conditioning, furnished by Worthington equipment.

Five years ago, when the hotel wished to expand its air conditioning, a Worthington centrifugal compressor was installed, with the original unit put aside for stand-by service.

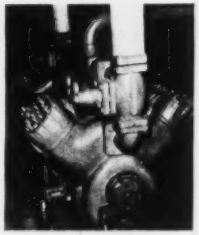
Last year, an annex to the hotel was built, and Worthington equipment was again selected: two Freon reciprocating compressors and one condenser.

Distributor: Frank Harmonson Co., Phoenix.

Westward Ho is Phoenix' largest hotel. It is completely Worthington-conditioned.

La Mina Room, one of the several dining rooms in the Westward Ho.

Cool, comfortable air, Worthington-supplied, adds to the charm of this typical suite in the Westward Ho annex.



Two Worthington Freon-12 6HF4 Compressors installed in the new annex.

Now They Trade in Comfort on the New Orleans Exchange

New Orleans Cotton Exchange —completely air-conditioned by Worthington.

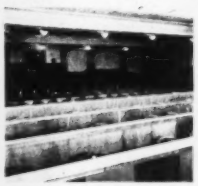
Consulting Engineers—Leo S. Weil and Walter B. Moses.

Contractor—Mayer Godchaux

During its nearly 80 years, The New Orleans Cotton Exchange has undoubtedly observed many scenes of feverish trading, but since 1948 the air, at least, has maintained a moderate temperature.

Worthington centrifugal refrigeration makes the difference. The Worthington system has a capacity to cool 420 gpm of water from 55.6 F to 46 F when supplied with 545 gpm of condensed water at a maximum of 87 F. Capacity rating for the entire system is 160 tons.

Worthington Makes a Hit in Sangamo's Auditorium



Auditorium in plant of Sangamo Electric Co., a leading manufacturer of electric measuring and control equipment, Springfield, Illinois.

The modern auditorium built by Sangamo Electric Corporation to be used as a meeting place for employee training courses, sales conferences, and employee organizations, provides the year-'round comfort of Worthington air conditioning.

The equipment, installed by Henson Robinson Co. of Springfield, Ill., includes a 3HF6 Freon-12 compressor, an AVY air conditioning unit, and an ECZ evaporative condenser. The system is rated at 15 tons and handles 4500 cfm. 95% of the condenser water is saved for re-use.

Here's how the system operates. A single off-on wall switch controls the entire system, with inter-locks for proper sequence of operation. A room-type cooling thermostat actuates a solenoid valve in the Freon liquid line. A heating thermostat actuates a modulating-type steam valve and modulating-type motor connected to air conditioning face and by-pass damper.

A manual modulating-type control and motor secure the desired mixture of fresh and recirculated air entering the unit (maximum 3000 cfm). Automatic change-over from heating to cooling cycle, or vice versa, is provided.

In order to prevent freezing of water in the evaporative condenser, located in the equipment room, a duct arrangement with temperature controller and damper motor was installed. This insures trouble-free operation when outside temperature falls below 35 F, since the evaporative condenser supply air is taken from the equipment room.

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

A complete line . . . in which *all* the vital components are *made*, not just assembled by Worthington. For *more worth with Worthington*, see your nearby Worthington distributor (consult Classified Telephone Directory).

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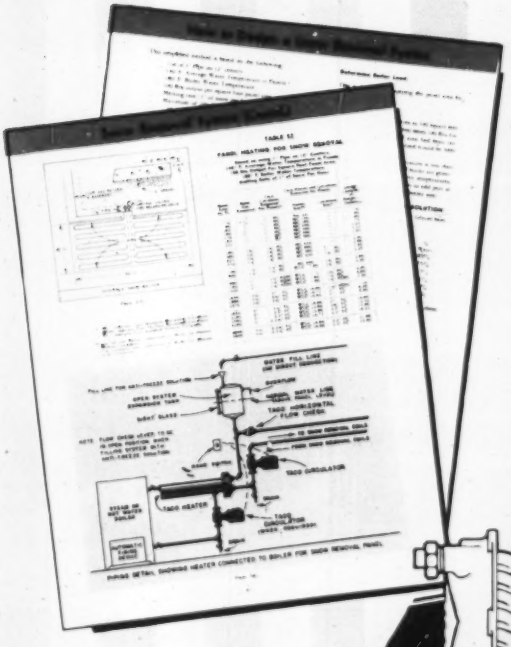

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For instance . . .

SIMPLIFIED . . . . ACCURATE INFORMATION THAT ENABLES YOU TO DESIGN QUICKLY AND CONFIDENTLY

These tables are not "short cut" in that we've sacrificed exactness for speed of figuring. They are *accurate* . . . and based on the latest engineering information. While we feature snow removal in this ad, the new catalog has accurate simplified tables on ceiling and floor panel heating as well as on one and two pipe forced hot water systems. Send for your copy today.

Better Heating-Better with Taco

Taco

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137 South St., Providence 3, R. I.

BRUNNER SINCE 1906 REFRIGERATION helps you serve better

Your Good Name and Ours

could form a profitable partnership

Talk to anyone in the trade who has specified and installed Brunner Refrigeration Condensing Units and they'll tell you *from experience* what it means in business dollars and cents to deal with a progressive, understanding organization that builds its products just a little bit better than is expected.

You, as a contractor, need not be told how much easier it is to "sell" a job when you are in a position to specify and deliver *known* and *accepted* equipment.

The Brunner Manufacturing Company, with all their 44 years continual growth, has moved ahead so fast these past few years there are still some aggressive contractors who have missed the important details of what we may be able to contribute to their efforts toward securing more *profitable* business.

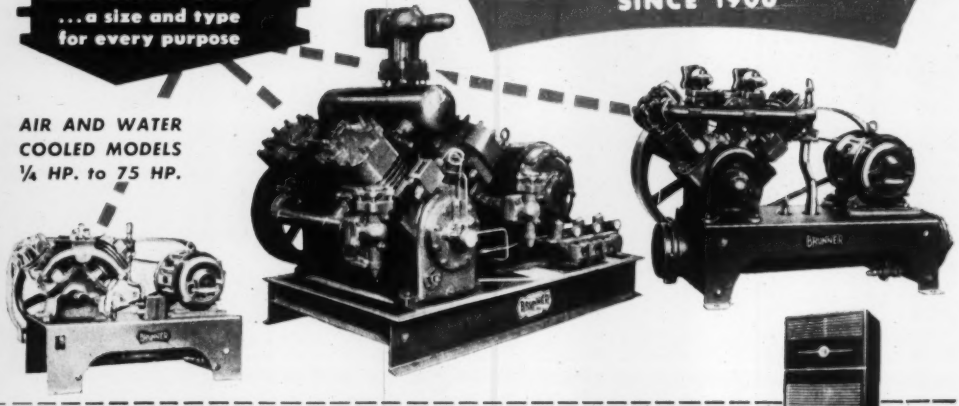
If you are at all concerned in the specifying and installation of refrigeration and air conditioning equipment, Brunner has a story to tell that you should at least know about. A factory representative will call without obligation. Write us and say when.

BRUNNER MANUFACTURING COMPANY
UTICA 1, NEW YORK, U. S. A.

REFRIGERATION CONDENSING UNITS
...a size and type for every purpose

BRUNNER SINCE 1906

AIR AND WATER COOLED MODELS 1/4 HP. to 75 HP.



BRUNNER SINCE 1906

AIR CONDITIONING
Self Contained Units in 4 sizes: 3 - 5 - 7½ and 10 HP.
Remote Installation Types from 5 to 75 HP.

No place for Rip Van Winkles

TWENTY years bring changes--changes far greater in our fast-moving world than ever happened in Rip Van Winkle's day.

Americans are awakening to unpalatable facts--that the enterprise system which built our nation and made it strong is being subtly undermined; that advocates of backdoor socialism and communism thrive in our midst; most dangerous of all, that our young people are misinformed on economics.

For example, a recent survey of high school seniors reveals that they estimated that it takes only an $81 investment to provide a job. Actually, as shown by the 1947 census, the 2256 establishments of the iron and steel industry invested $545 per worker that year alone in *new* plant and equipment. Total investment to provide one job runs well above $10,000.

These youth had a similarly distorted picture of profits. They believe shareholders receive 24% of the sales dollar whereas they receive an average of less than 3%.

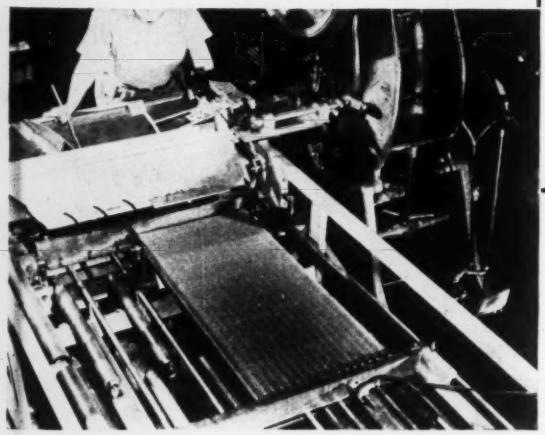
Misinformed minds are a ready field for imported false philosophies. And it is up to you, a business leader in your community, to take responsibility toward correcting these misunderstandings. The American businessman must not permit himself to be lost in Rip Van Winkle befuddlement.

THE YOUNGSTOWN SHEET & TUBE CO. 1900 YOUNGSTOWN 1950 50 YEARS OF SERVICE

The Youngstown Sheet and Tube Company
General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

ELECTROLYTIC TIN PLATE - COKE TIN PLATE - WIRE - COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - CONDUIT - RODS - SHEETS - PLATES - BARS - RAILROAD TRACK SPIKES.

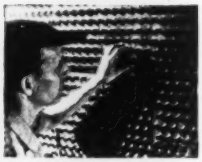
In cooling or heating coils



Specially-designed fin punching and stacking machinery makes possible high production along with high quality.

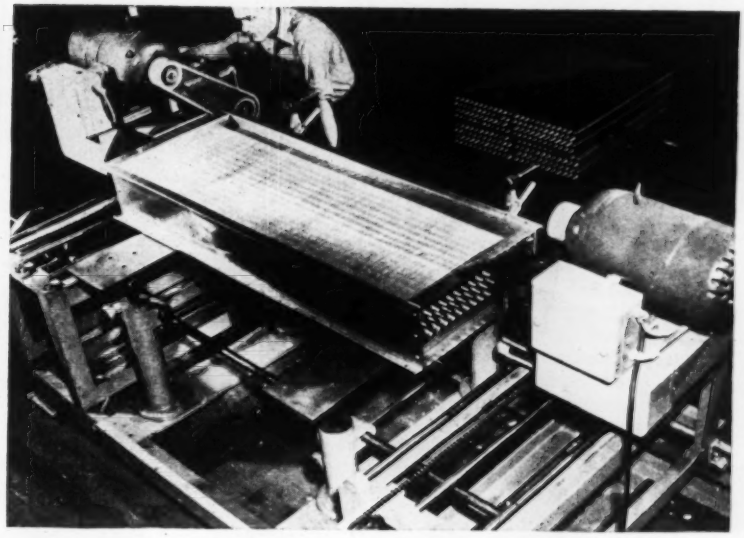
Sturtevant

GIVES YOU PROVEN PERFORMANCE



Uniformity of workmanship, quality, and performance are built into every Sturtevant coil.

Proper expansion of tubes provides best heat distribution to finned surfaces.



Special coil manufacturing equipment assures uniformity of coil quality and dependability.

For practically every cooling or heating application, you will find a Sturtevant coil that fills your needs. Because it is built under rigid specifications by skilled craftsmen using specialized equipment, it will be a quality product—with performance *proved* through years of successful installations.

Take the U. S. Department of the Interior Building in Washington, D. C., as an example. The thousands of Sturtevant coils installed there in 1934 have performed perfectly ever since. This is only one of many installations with a record of 15 years or more of efficient service.

Sturtevant's complete, standardized line contains all types and sizes of heat transfer coils. They are available in a wide range of capacities, with aluminum or copper fins that offer minimum resistance to air flow and are easy to clean.

By specifying Sturtevant, you are assured of long coil life at rated performance . . . the product of sound engineering, modern tooling and first-class workmanship. Call your nearest Westinghouse Sturtevant Office, or write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

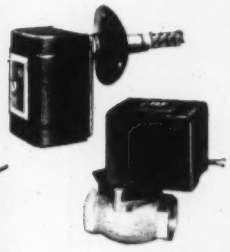
YOU CAN BE SURE...IF IT'S

Westinghouse

demand DETROIT CERTIFIED CONTROLS

CONSUMER APPEAL—*Timed Cycling*—"The Thermostat With a Brain"—is a sales natural because it virtually eliminates the many heating discomforts your customers had accepted as inevitable—and *Timed Cycling* is available *at no extra cost*, in DETROIT thermostats for every type of heating system!

CERTIFIED—The *Timed Cycling* Room Thermostat, like all DETROIT controls, is certified by the manufacturer for reliability, performance and engineering excellence!



COMPLETE LINE—DETROIT offers a complete line of superior automatic heating controls from one convenient source—the only heating controls certified for successful operation!

NATIONALLY ADVERTISED—The tremendous power of The Saturday Evening Post and Better Homes and Gardens, reaching over 7,000,000 people, has carried news of *Timed Cycling* into the homes of your potential customers!

CONSUMER LITERATURE—DETROIT'S colorful, informative booklet on how *Timed Cycling* brings truly modern heat control, is being currently mailed to homeowners and homebuilders the country over!

"TIMED CYCLING" and ONLY "TIMED CYCLING"

Gives You All These Sales Advantages!

All of the advantages listed above—and more! For DETROIT'S broad line of finely engineered heating controls is backed by a nation-wide organization, trained to help you with your sales and service problems. It will pay you to demand DETROIT'S complete line of controls from your wholesaler because it's one sure way to profit through greater sales and customer satisfaction. Further information on *Timed Cycling* and the complete line of DETROIT certified controls is yours on request. Write today for Form No. 1545 and Bulletin No. 227.

DETROIT
LUBRICATOR COMPANY

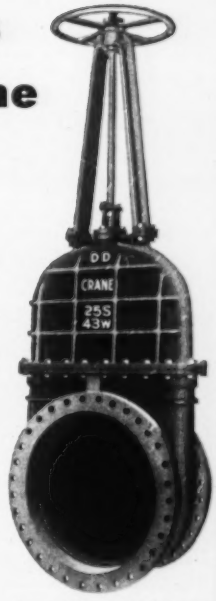
5900 TRUMBULL AVE., DETROIT 8, MICHIGAN
Division of American Radiator & Standard Sanitary Corporation
Canadian Representatives: RAILWAY & ENGINEERING SPECIALTIES, LTD.—Montreal, Toronto, Winnipeg

DETROIT

DETROIT HEATING AND REFRIGERATION CONTROLS • ENGINE SAFETY CONTROLS • FLOAT VALVES AND OIL BURNER EQUIPMENT • DETROIT EXPANSION VALVES AND REFRIGERATION ACCESSORIES • STATIONARY AND LOCOMOTIVE LUBRICATORS

Serving home and industry AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • BOSS HEATER • TONAWANDA IRON

How to simplify your piping jobs ...Standardize on the CRANE line



No. 793½, Outside Screw and Yoke. Working Pressures: 25 pounds steam or gas; up to 50 pounds cold water. Sizes: 10 to 48-inch.

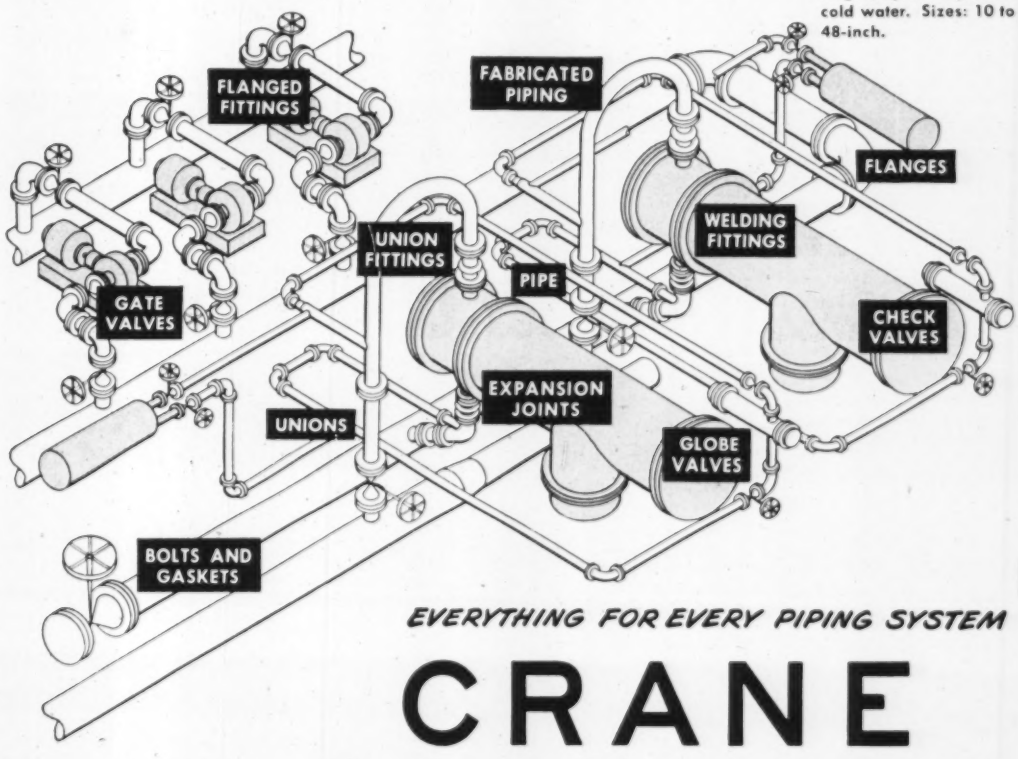
ECONOMICAL VALVES FOR LOW PRESSURES

Keep Crane 25-Pound Iron Body Double Disc Gates in mind for services that don't require the usual 125-Pound valves. Rated at 25 Pounds Steam or Gas, and up to 50 Pounds Water, depending on size, they give superior service in a wide variety of applications. Use them inside or out; their oval-shaped body and bonnet have ample reserve strength under line stresses. Short and compact, they take minimum space in pipe lines.

For durable, tight seating—yet easy opening—seat rings and disc faces are brass. Crane 2-piece ball-type gland maintains uniform pressure on packing; prevents binding on stem; lengthens packing life. When specified, these valves can be fitted with gears, by-pass, and clean-outs; also can be motor or cylinder operated; non-rising stem, flanged or hub ends, up to 36-in.; O.S. & Y. type with flanged ends only up to 48-in. See your No. 49 Crane Catalog.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

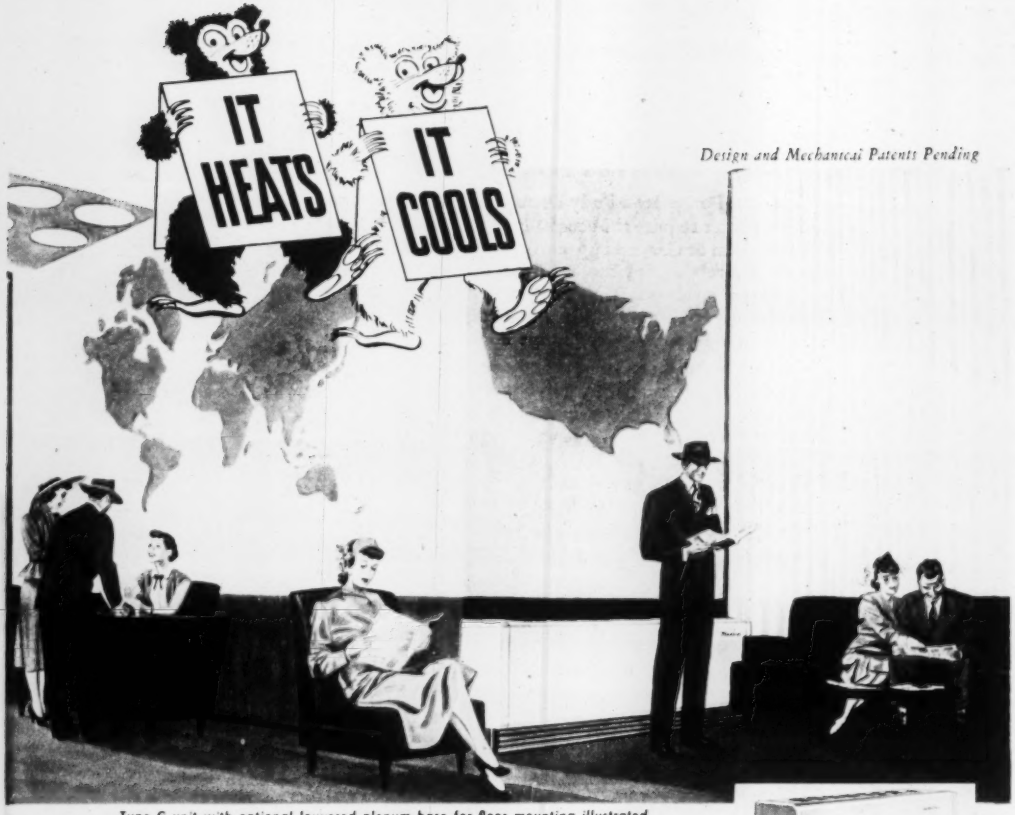
ONE ORDER TO CRANE COMPLETELY EQUIPS CIRCULATING, COOLING AND SERVICE WATER PIPING SYSTEMS



EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING



Design and Mechanical Patents Pending

Type C unit with optional louvered plenum base for floor mounting illustrated.

It's the NEW *Modine* Cabinet Unit

THE new Modine Cabinet Unit — yours for fast, positive distribution of *heated or cooled air!* Perfect for stores, showrooms, schools, lobbies . . . all modern commercial and public buildings. Available in 5 capacities — from 120 to 640 Edr.

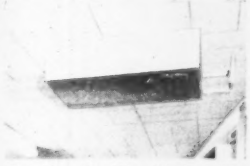
- Winter's chill, summer's hot blast are problems no more! Single unit for forced hot water heating . . . cold water cooling. Steam models for heating only.
- For fresh air ventilation, non-freeze steam coil and built-in mixing damper available.
- Hushed performance insured by skillful silencing of mechanical and air-rush noises.
- New, specially designed water coil gives you high capacity hot water heating — 2 lbs. steam performance on 180° water.
- Smartest styling is yours . . . with beige-gray enamel finish, Parker-Bonderized for lasting beauty.
- You get easy accessibility to motor, blowers, coil, and piping simply by removing the front panel.

WRITE FOR NEW BULLETIN 550 TODAY!

You'll find your Modine Representative listed in the classified section of your phone book. Or write direct. Modine Mfg. Co., 1509 Dekoven Ave., Racine, Wis.

Modine
CABINET UNITS
FOR HEATING & COOLING

Type C — basic unit for wall mounting. Adaptable to other installations.

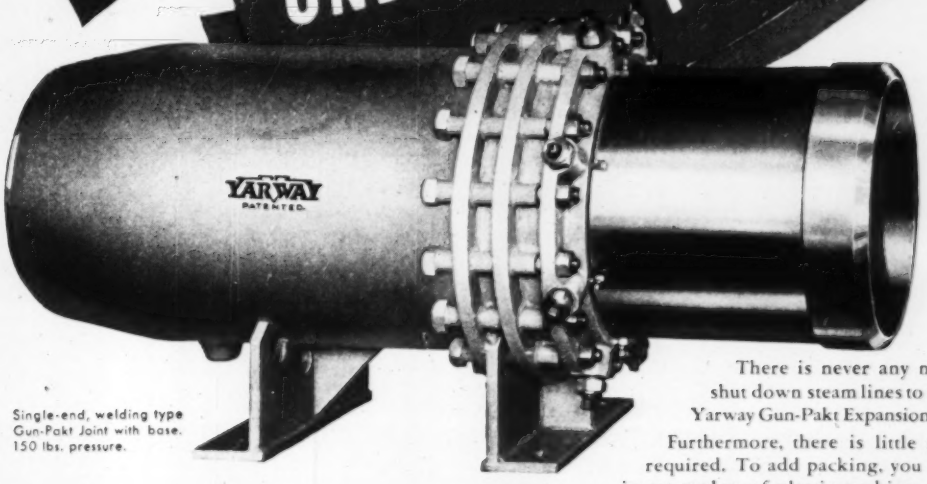


Type C, with optional inlet grille, for ceiling mounting. Duct connectors also available.

Type CR with face outlet grille and plenum base for recessed installation.

U-1066

THIS EXPANSION JOINT IS SERVICED UNDER FULL STEAM PRESSURE



Single-end, welding type Gun-Pakt Joint with base. 150 lbs. pressure.

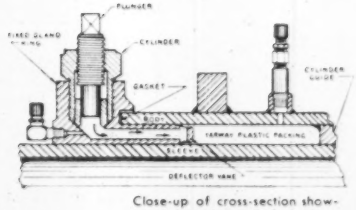
There is never any need to shut down steam lines to service Yarway Gun-Pakt Expansion Joints.

Furthermore, there is little service required. To add packing, you simply insert a plug of plastic packing, turn a wrench, and the job's done! Special Alemite fittings provide for proper lubrication.

Maintenance costs are trifling. One large user reports 65 cents per year per joint. Others claim less than that.

Gun-Pakt Joints are available with single or double-ends, welding or flanged types, in sizes from 2" to 30", with traverses from 4" to 24", and for pressures to 400 psi.

For the full Gun-Pakt story, write for Yarway Bulletin EJ-1912.



Close-up of cross-section showing detail of Gun-Pakt feature.

YARNALL-WARING COMPANY
107 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY **GUN-PAKT EXPANSION JOINT**

From the

GREAT LAKES

Gimbel Brothers Department Store
Milwaukee, Wisconsin

To the

RIO GRANDE

St. Thomas High School
Houston, Texas

Architect & Consulting Engineer
Maurice J. Sullivan
Houston, Texas

VARI-VAC DIFFERENTIAL HEATING

cuts fuel costs up to 40%

Provides unsurpassed comfort year 'round . . . in any climate. Whether you are buying for a building in the North or the South . . . a multi-storied structure or a sprawling 2400-family housing project . . . Dunham Vari-Vac* Differential Heating can *cut your customer's fuel costs up to 40%.*

How? By utilizing a continuous flow of sub-atmospheric steam at temperatures that vary automatically with the outside weather. This heating system with its precision temperature control system has proved so successful in installations all over the country that Dunham has even *guaranteed—in writing*—fuel reductions of 25% for many buildings.

Job-scaled to your size

This remarkably economical system is adaptable to any type of structure . . . any size . . . to fit any budget. Seven different systems are available. There's one to fit every need.

Don't overlook this *guaranteed* way to slash your customer's operating costs by keeping heat supply and demand in perfect balance at all times. It will pay you to investigate Dunham Vari-Vac . . . regardless of the type of building you are working on.

FREE BOOKLET TELLS THE STORY

Bulletin 509 gives you complete information about Dunham "Job-scaled" Vari-Vac Heating; tells you what it is, how it operates, how it may be fitted exactly to your needs.

C. A. Dunham Co., 400 W. Madison St., Chicago 6, Ill.
In Canada: C. A. Dunham Co., Ltd., Toronto
In England: C. A. Dunham Co., Ltd., London

*Variable Vacuum

CONVECTOR RADIATION, BASEBOARD RADIATION,

UNIT HEATERS, TRAPS, VALVES, PUMPS

DUNHAM

HEATING MEANS BETTER HEATING

your SPANG CW distributor *Believes in Quality*

Your Spang CW Distributor places a high value on customer goodwill. And he does a lot of things to maintain it.

For instance, he stocks quality products. That's why he handles Spang CW Pipe. He knows that he can recommend it with full confidence . . . that it will deliver long, economical life in an infinite variety of applications. Furthermore, he knows that Spang CW Pipe has the kind of quality that makes it easy to weld, bend, cut and thread.

And your Spang CW Distributor likes to provide quality service . . . the kind that you can depend on all the time . . . anytime . . . in any emergency.

Next time you need pipe, fittings, fixtures, valves or other piping materials, call your Spang CW Distributor first. We think that you'll see what we mean.

SPANG-CHALFANT

Division of The National Supply Company

GENERAL SALES OFFICES: PITTSBURGH, PA.

District Sales Offices: Atlanta; Boston; Chicago; Detroit; Houston; Los Angeles; New York; Philadelphia; Pittsburgh; St. Louis; San Francisco

SPANG

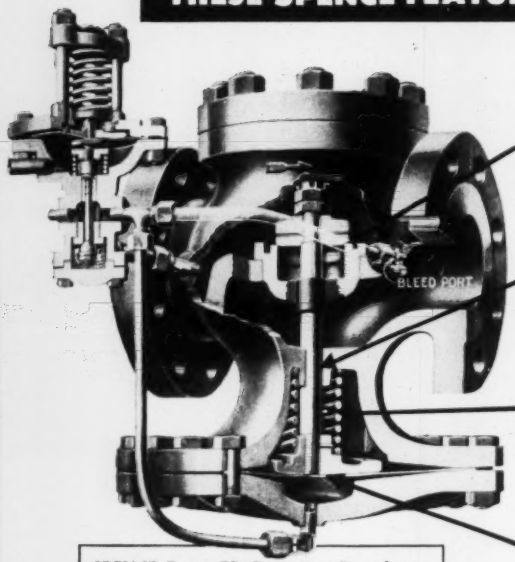
CW

QUALITY *that is recognized wherever pipe is used*

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. *More than twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

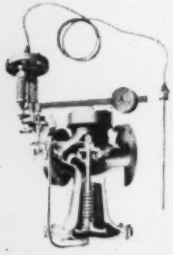
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

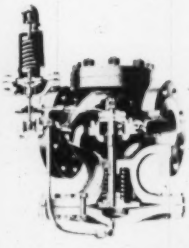
LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

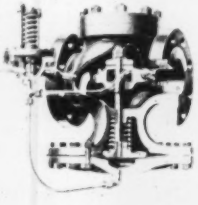
Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.



Type ET150 Temperature Regulator—Tops in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

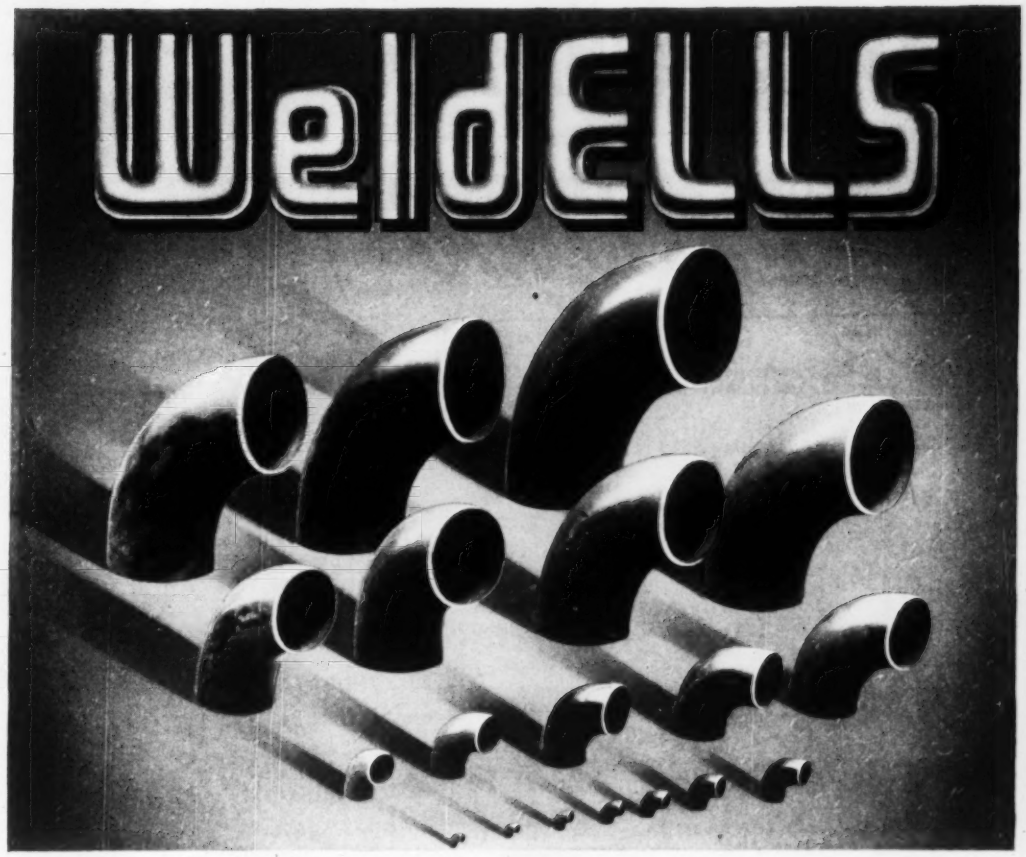
These Companies Have Profited with SPENCE!

The Springs Cotton Mills
Ford Motor Company
Pennsylvania Power & Light Company
Jones & Laughlin Steel Corporation
National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence



Family Group . . . *proud of its size . . . and traditions*

Large group though it is, you see here only one branch of the world's largest family of fittings for pipe welding.

It is simply the stock sizes of long-radius WeldELLS in a single weight and material — merely a small fraction of the enormous line that includes more types of fittings, in more materials, more weights and more sizes than any other line.

Important though the breadth of the WeldELL line is to every man who designs or erects piping, still more important is the significant fact that the WeldELL family grew to this size because nothing less could meet the demand for fittings of WeldELL quality and uniformity to satisfy every conceivable piping condition.

Yes, there is a Taylor Forge Fitting for every purpose. From the smallest to the largest, every fitting in the WeldELL line shares the principle of sound engineering design and job-speeding utility that Taylor Forge has consistently applied for half a century.

Mail the coupon for Taylor Forge catalog.

TAYLOR FORGE

TAYLOR SPIRAL PIPE is again promptly available in a broad range of sizes and thicknesses. Coupon brings new Spiral Pipe Bulletin 493.

TAYLOR FORGE & PIPE WORKS
P. O. Box 485, Chicago 90, Illinois
Offices in all principal cities: *Eastern Plant:* Carnegie, Pa.
Western Plant: Fontana, Calif.

Please send Catalog 484 covering welding fittings and forged steel flanges.
Send Bulletin 493 covering Taylor Spiral Pipe and related fittings.

NAME _____

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Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

510-0850

DRAVO HEATERS

Saved $530,000*

in mammoth new auto plant

Compared with conventional steam system cost.

Half a million is important money in anybody's language —and it gets more important when it's SAVED instead of spent.

That's just what happened when a leading automobile manufacturer recently built a mammoth new body stamping plant, with over 600,000 sq. ft. of floor space, and with ceiling heights ranging up to 52 feet. Heat requirements, including fresh air tempering provisions, totalled 54,250,000 Btu. Lowest quoted price for a conventional steam boiler plant was $860,000. ACTUAL cost of a complete Dravo *Counterflo* Heater installation of 53 units was $330,000. These direct-fired warm-air heaters take care of all open-space heating requirements of the manufacturing area of the plant.

Bear in mind that these savings involved no compromise with heating effectiveness. The top-flight engineers responsible for selection knew how vital *comfort* is in keeping employes contented and promoting top output. They looked *first* for the finest in heating results . . . and *second* for economies. They found both profitably combined in Dravo Heaters.

Neither did this saving come from "cutting corners" in building the heater, but rather through the basic simplicity of method and equipment. Each of the oil-fired space heaters manufactures heat "on demand" to blanket its own assigned area with warmth. It also introduces fresh, tempered air into the building as needed. Modulating burner controls permit continuous operation and continuous air circulation. This minimizes temperature fluctuation, assures maximum comfort in all weathers, and conserves fuel—for when any section needs LESS heat, its unit burns LESS fuel. Units all have the Underwriters' Laboratories label. They can be converted from oil to gas, should the fuel situation make this desirable.

This spectacular saving has been duplicated on a lesser scale in thousands of smaller plants. If you are concerned with heating any new or old building, you owe it to yourself to find out how Dravo *Counterflo* Heaters are serving and saving for others . . . and how they can save both system costs and operating costs for YOU. Look in the yellow section of your phone book—or write us direct at Dravo Building, Pittsburgh 22, Pa., for Bulletin FG-523-687.

DRAVO

DRAVO CORPORATION

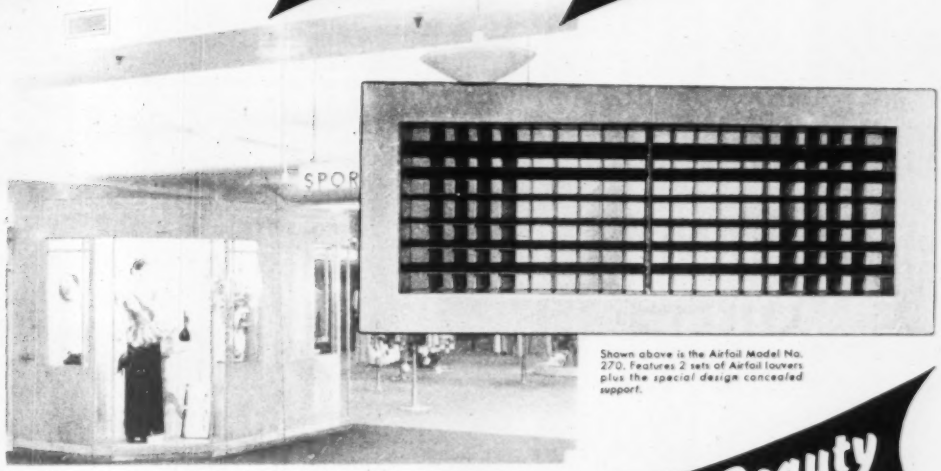
PITTSBURGH • CLEVELAND • PHILADELPHIA • DETROIT • NEW YORK • CHICAGO • ATLANTA • BOSTON

Sales Representatives in Principal Cities. Mfd. and Sold in Canada by Marine Industries, Ltd., Sorel, Quebec.

Export Associates: Lynch, Wilde & Co., Washington 9, D. C.

LEADER IN ITS FIELD

Outperforms **Costs Less** **Installs Easier**

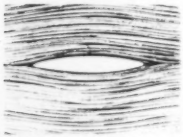


Shown above is the Airfoil Model No. 270. Features 2 sets of Airfoil louvers plus the *special design concealed support.*

Adds Beauty

Airfoil

AIR CONDITIONING OUTLETS



Illustrated above — Streamlined Airfoil louver knifes the air in wind tunnel tests. Note how turbulence has been almost completely eliminated.

Airfoil Grilles feature the ***FIRST REALLY NEW IDEA*** in air conditioning outlet design —the streamlined, smooth-as-glass ***Airfoil Louver.*** This louver—adapted from the aerodynamically perfect airfoil section of an airplane—makes possible matchless air diffusion and distribution. Airfoil Grilles handle higher air velocities with minimum turbulence, minimum noise and perfect draft-free performance. Blades are individually adjustable—made in solid sections of extruded material.

Enthusiastic contractors, architects and engineers—Nation-wide—declare these ***new Titus Airfoil Grilles outmode all others.***

Their design handles air diffusion and distribution like no other grille ever has.

THE *Airfoil* LINE IS COMPLETE

- Air Conditioning Outlets
- Return Air Grilles
- Return Air Registers
- Volume Controllers
- Ceiling Outlets
- Perforated Metal Grilles
- Ornamental Grilles
- Door Ventilators
- Marine Diffusers
- Industrial Air Distributors
- Floor Registers
- Automatic Back Pressure Dampers
- Grilles for Room Air Conditioners
- Special Made-to-Order Grilles
- Installation Frames and Accessories
- High Velocity Factory Outlets
- Toilet Exhaust Registers
- Plain Lattice Grilles
- Grilles for Convector Radiators

AUTHORIZED REPRESENTATIVES IN ALL PRINCIPAL CITIES

TITUS MANUFACTURING CORP.
WATERLOO, IOWA

Gentlemen: Please rush me complete information including prices, discounts and delivery on the complete Airfoil line.

NAME .....

ADDRESS .....

CITY ..... STATE .....

Neat jobs like this

easy to form with U·S·S GALVANIZED SHEETS

HERE'S WHY: Uniform in ductility, flatness and coating, U·S·S Galvanized Sheets are easy to fabricate. You get true bends, tight seams and neat joints —even in forming the most difficult angles and shapes. And their tightly adhering coating of zinc assures long life and a finish that contributes to the pleasing appearance and salability of every job you turn out.

But workability is not the only reason for the tremendous popularity of these superior steel sheets. The most widely advertised and best-known sheets in the industry, they enjoy a public acceptance second to none. Customers know that the familiar U·S·S trademark stands for dependable quality.

To stand up under severe atmospheric conditions

U·S·S GALVANIZED COPPER STEEL SHEETS

—give twice the atmospheric corrosion resistance at little additional cost!

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
UNITED STATES STEEL SUPPLY COMPANY, WAREHOUSE DISTRIBUTORS, COAST TO COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

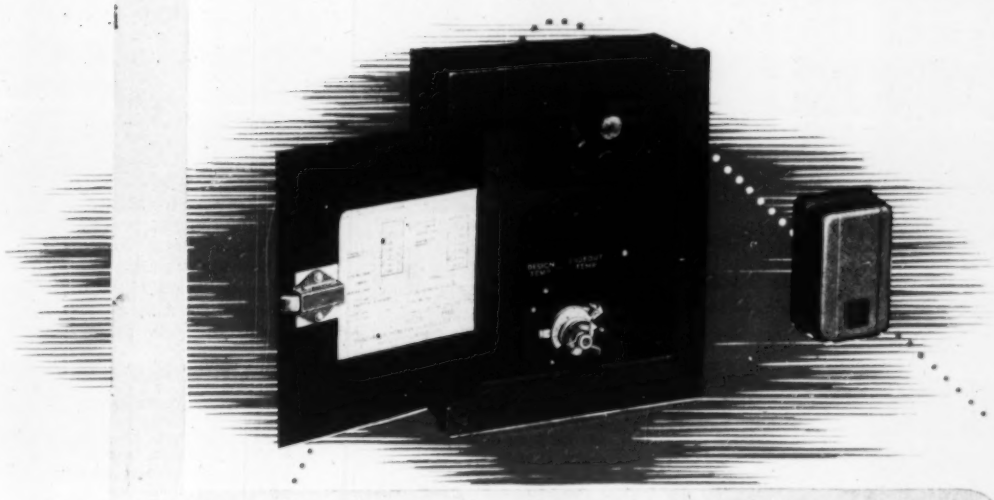
USS TRADE MARK

GALVANIZED STEEL SHEETS

UNITED STATES STEEL

THE NEW HONEYWELL OUTDOOR CONTROLLER

Cyclotrol . . . An Electronic Control Package for Burner and Zone Valve Control—Provides Automatic Night Shutdown and Morning Pickup—Low in Cost—Simple to Install—Saves Fuel



A REAL FUEL SAVER FOR APARTMENTS, HOTELS AND COMMERCIAL BUILDINGS

HERE'S a new Honeywell Electronic Outdoor Control package that affords great fuel economy and can be easily installed by any workman. Especially designed for apartments, hotels and commercial buildings, this new control automatically determines the length of both the on and off periods in accordance with outdoor weather conditions, rather than the conventional fixed time cycle. Being electronic it is supersensitive, fast in response and has no moving parts. It is low priced, easy to install, easy to adjust and, above all, it saves fuel. Investigate this new Honeywell outdoor controller at once. Then recommend and install it for your clients.

Send for our new descriptive booklet, SA 1501

MINNEAPOLIS **Honeywell**
CONTROL SYSTEMS

77 BRANCHES FROM COAST TO COAST WITH SUBSIDIARY COMPANIES IN TORONTO • LONDON • STOCKHOLM • AMSTERDAM • BRUSSELS • ZURICH • MEXICO CITY

This is the Kind of Idea That Wins a Hundred Bucks

"I apply Aerocor with pitch, then secure it with glass tape, and spray paint it."

"I cut Fiberglas Coated Duct on the job with a jackknife."

"I line with Coated Duct the Stik-Clip way, and often cover with Aerocor."

WIN $100!

No Limit to the Number of Winners!

Just answer the question:

WHAT'LL THEY DO NEXT WITH

OWENS-CORNING
FIBERGLAS
REG. U.S. PAT. OFF.

?

Aerocor* and Coated Duct Insulations

Probably you've already earned your hundred bucks—all you have to do now is tell us about it! Surely, someplace in your work you have made an interesting, new, unusual application of Fiberglas insulation. Well, say so—and the money is yours!

These surprising materials have revolutionized insulating practice. They're so adaptable that new applications and application methods come up daily. So—we want to pass the word along nationally. That's the reason for this easy contest. Send in your entry, get the easiest hundred bucks you ever earned!

Rules of the Contest

Write us a letter describing a **NEW OR UNUSUAL APPLICATION OR APPLICATION METHOD** of Fiberglas* Aerocor or Coated Duct Insulation. A letter stands to win $50 **OR $100 IF ACCOMPANIED BY A SNAPSHOT OF THE JOB.** Literary style or quality of photo are not considered in judging. **EACH ACCEPTED ENTRY** receives $50, or $100 if accompanied by a snapshot. Judges' decisions are final. Judges are: A recognized Heating and Ventilating Engineer, an Editor of this magazine, an Owens-Corning Fiberglas Corporation Technical Man. All entries become the property of this company. To qualify, an entry must be at the Owens-Corning Fiberglas Corporation office not later than **MIDNIGHT, OCTOBER 30, 1950.**

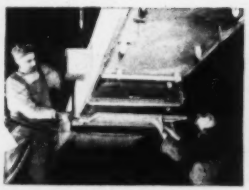
Want an extra hundred dollars? Chances are you already have a likely application! LET'S GO!

OWENS-CORNING FIBERGLAS CORPORATION
Dept. 40-H, Toledo 1, Ohio

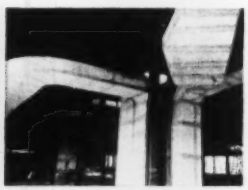
Fiberglas is in your life . . . for GOOD!

*Fiberglas is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corp. for a variety of products made of or with fibers of glass. Aerocor is a trade-mark of Owens-Corning Fiberglas Corp.

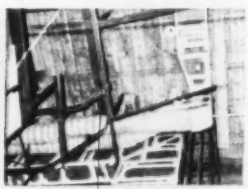
These are typical, everyday uses



Fiberglas Coated Duct Insulation inside and outside a duct. It resists erosion up to 5,000 FPM.



Fiberglas Aerocor on an irregular, heated surface. Weight for weight this insulation has the lowest heat conductivity known.



Fiberglas Aerocor applies quickly with glass tape, wire, or an undercoat of pitch or bitumen.

Curtis Motors Inc., progressive Dodge and Plymouth dealers of Mechanicsburg, Pa., rely on Carrier Horizontal Discharge Units for efficient, low-cost heat.

THE HEAT'S ON FOR SALES AND SAVINGS!

Here's an installation that satisfies all concerned: Curtis Motors because it provides comfortable heat at a saving in this glass-enclosed salesroom—and the contractor because a job well done leads to other profitable jobs.

The Carrier Horizontal Discharge Units that licked this problem have a new single-row coil construction which offers less air resistance and increases range of discharge. Quiet in operation, they're so attractive they're ideal for showrooms (or restaurants or quality stores)—and so rugged they're right for garages and factories. For use with steam or hot water, they're available in capacities from 13,400 to 200,000 Btu's per hour.

There's a Carrier Unit for every need—Gas-Fired Units for use where gas is the fuel . . . Four-Way Directed-Flo Units, with steam or hot water, for buildings best served by quick heat from relatively high ceiling suspension . . . and Heat Diffusers, floor or ceiling mounted, for large enclosed areas. Every Carrier Unit is field-tested for superior performance. For information, write Carrier Corporation, Syracuse, New York.

Carrier

AIR CONDITIONING
REFRIGERATION
INDUSTRIAL HEATING

H&H and savings and Service in Brass and Copper Tubing

A TYPICAL REPORT:

"No wonder more and more tubing buyers in every field are turning to H+H— their H+H Lockseam Tube suits us to a 'T'"

Whether you buy tubing for plumbing, heating, air conditioning, automotive or aviation purposes, H & H has the tubing that's exactly right for you. Pictured here, for example, is H & H Lockseam Tube, a strong edge seam tubing that's made round or oval in sizes to meet requirements in the heating and cooling fields. Because H & H reroll and continuous strip annealing facilities are among the finest, uniform temper is always the result. Because close tolerances are maintained, a good solid bond is insured at all times. So if it's quality, service and savings you want, it will pay you to consult the H & H representative nearest you. Why not do it today?

Originators and sole makers of "Metalflo"— the economy tubing

H & H TUBE AND MANUFACTURING COMPANY

246 N. Forman Avenue • Detroit 17, Michigan • VInewood 2-3600

METALFLO · LOCKSEAM · COIL STRIP AND SEAMLESS TUBING · TUBULAR PARTS

The Importance of the Revolving Discharge Outlet in the Heating of Industrial Buildings

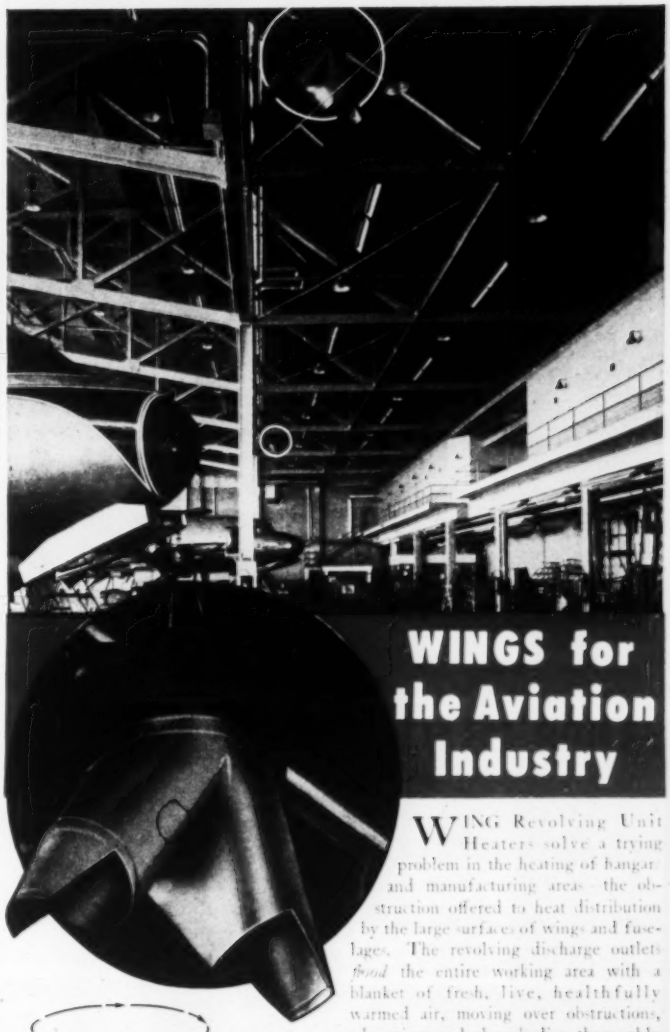
by D. Gilbert

The almost universal use of unit heaters for industrial plant heating indicates a conviction on the part of plant engineers, managers, consulting engineers and architects that this is the most satisfactory way of heating buildings and work rooms. Industry has come a long way, indeed, from the days not too long ago, when pipe coils, suspended from side walls or under windows, were the common means of heating a plant.

But, as pointed out in the article on Unit Heaters in a leading authoritative publication:

"In order to direct the air to points desired, and to diffuse the air to avoid drafts, unit heaters are commonly equipped with directional outlets, adjustable louvers, or fixed types of diffusers. . . . As hot blasts of air in the working zone are usually objectionable, heaters mounted on the floor should have their discharge outlets above the head line, and suspended heaters should be placed in such manner and turned in such direction that the heated air stream will not be objectionable in the working zone."

This is sound advice, but even with such stratagems, it is seldom possible to obtain satisfactory results. The basic difficulty lies in the use of *stationary* discharge outlets. Only one type of unit heater is able to avoid the objectionable "hot blasts" so distressing to workers in fixed positions, as on assembly lines or at machine tools. That is the heater suspended from roof or ceiling in which the downward discharge of heated air is distributed by slowly *revolving* discharge outlets. There are no fixed blasts, no chilly corners untouched by the air streams, just a gentle, thorough movement of the heated air at the working level, over obstacles, around obstructions, moving under tables, benches, truck bodies, airplane wings, even into repair pits. The result is an evenly warmed blanket of air at the working level, a gently moving, invigorating atmosphere that is pleasantly stimulating to the worker and better for his health.



WINGS for the Aviation Industry

WING Revolving Unit Heaters solve a trying problem in the heating of hangar and manufacturing areas—the obstruction offered to heat distribution by the large surfaces of wings and fuselages. The revolving discharge outlets *flood* the entire working area with a blanket of fresh, live, healthfully warmed air, moving over obstructions, under wings and plane bodies, thoroughly and evenly heating remote corners and galleries. There is a Wing Revolving Heater for *your* type of plant, too. Write for publication HR-5.

The Wing Revolving Discharge Outlets turn slowly through a complete circle about once every two minutes.

L. J. Wing Mfg. Co.

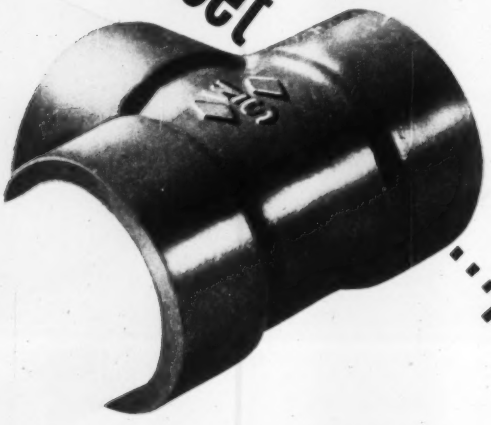
140 Vreeland Mills Road
Linden, N. J.

Canadian Factory: Montreal

Wing

Revolving UNIT HEATERS

Wherever pipes meet



...permanently

IN THE REFRIGERATION FIELD,

the surest and safest way to prevent fittings leaks is to install W-S Double-diamond Screw End and Socket Weld Forged Steel Fittings.

Designs are carefully engineered. Basic Materials are selected from a wide choice of carbon, stainless and alloy steels. Drop forging and precision machining makes them light in weight, assures accuracy of finish, and, all are instrument inspected for perfection of threads, sockets, angles and concentricity. Investigate them today.

Write for Bulletin A3-50. For information on stainless and alloy steel fittings ask for Bulletin S-1.

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

SPECIFY...

W S

FORGED STEEL FITTINGS

DISTRIBUTORS PRODUCTS DIVISION **WATSON-STILLMAN** ESTABLISHED 1848 • ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

TRANE *Presents...*

Trane Gas Unit Heater, with Louver Fin Diffuser

Trane Gas Unit Heaters are built of steel heavier than AGA standard

A new GAS UNIT HEATER BUILT LIKE A BOILER

It's new! It's attractive and functional! It's built like a boiler! That's the Trane Gas Fired Unit Heater.

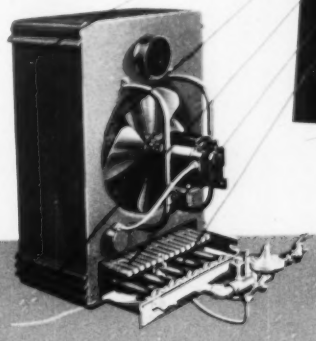
Heart of the unit is the exclusive Torrid Tube Heat Exchanger. Its steel tubes, generously sized for easy air passage, are rolled into heavy end sheets, boiler tube style — *fortified with additional outer and inner rolled flanges.* Completely leakproof. Built for continuous, heavy duty service.

Note, in illustration below, the new, improved *one-piece* burner assembly. Cast iron burners, together with mixing tubes, pilot light and valves are mounted so that they can be withdrawn *as a unit* for quick, easy maintenance.

The Trane office in your area is ready to supply you with complete details on the long-life design of this ruggedly attractive Trane high capacity gas unit heater.

THESE GREAT FEATURES

1. Sturdily attractive unit fits everywhere.
2. Husky heat exchanger "built like a boiler".
3. Masked secondary air openings improve appearance.
4. One-piece cast iron burners and mixing tubes—permanently correct.
5. Unitary design of burners, pilot, valves speeds maintenance.



Trane Gas Unit Heaters carry both AGA and UL approval.

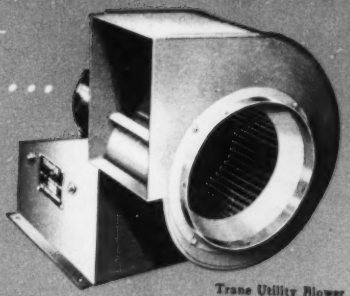
NEW COMPLETE CATALOG

Just in from the printers — 12-page bulletin contains details on construction advantages, capacities, and other pertinent data on all seven gas unit heater sizes. Ask the Trane Sales office in your area for your copy now.

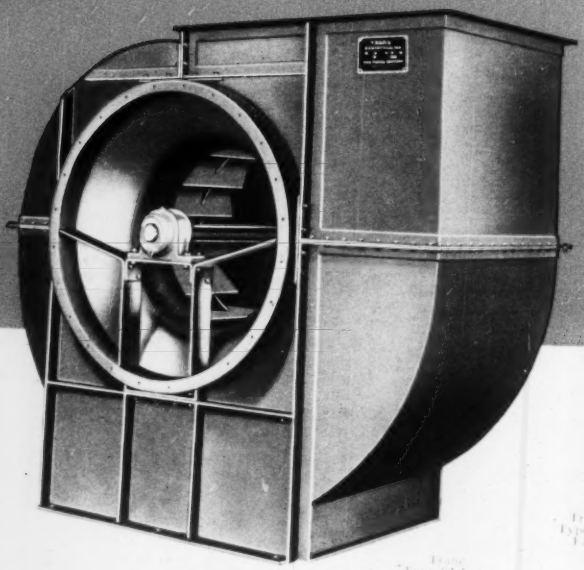
TURN THE PAGE!

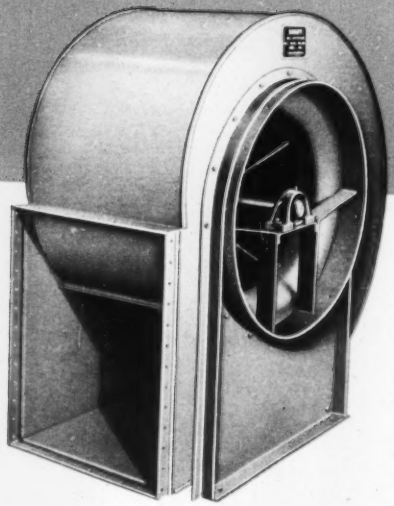
New Fans, New Projection Heaters, New Diffusers are announced.

TRANE *Presents...*



Trane Utility Blower





A new COMPLETE FAN LINE

NEW WIDE RANGE OF SIZES — NEW CONSTRUCTION FEATURES — CERTIFIED RATINGS

MATCH THESE FEATURES

1. Low Horsepower--designed for greatest over-all efficiency.
2. Low Noise Level--quiet operation in all sizes.
3. Maximum Outlet Openings--outlet velocities kept at a minimum.
4. Quality Construction--heavy gage steel, husky bearings and heavier shafts.
5. Durable Finish--every fan protected by rubberbase enamel.
6. Rigid Bracing--angle-iron frame and steel apron provide dual strength.

Now — a new Trane Fan Line. The manufacturing engineers who introduced the convector — perfected the projection heater — developed new methods of multi-room air conditioning, present an entirely new and more complete line of centrifugal fans. Trane, drawing on its quarter-of-a-century in building fans separately and for hundreds of thousands of heating and cooling units, has created

1. A new Trane Type BI Fan with *Backward Inclined Blades*.
2. A new Trane Type FC Fan with *Forward Curved Blades*.

TURN THE PAGE!

Class I and II Fans

The new Trane Fans are available in Class I and II construction. They can now be used in every heating and air conditioning installation as well as most industrial applications.

Certified Ratings

Trane Fans have Certified Ratings. *Each Trane Fan is rated in accordance with the Standard Test Code for Centrifugal Fans* approved jointly by NAFM and the ASH&VE, and close manufacturing tolerances are rigidly maintained.

Complete Line

The line is complete: Type BI Fans are available in 23 sizes. Type FC in 21 sizes. Wheel diameters range from 12" to 108". All arrangements. All direction of rotations.

Complete Accessories

To make the Trane Fan Line even more comprehensive, a complete array of special features and accessories have been made available. Included are such items as discharge dampers, inlet vanes, inlet screens, high temperature modifications, sparkproof fans, fans of special metals or with corrosion resistant coatings, gas tight housings with shaft seal and many more.

NEW LITERATURE THAT TELLS EFFICIENCY AT A GLANCE

Trane Fan Line literature is ready. Featured for the first time is an entirely new idea in fan data. Rating tables tell fan efficiency at a glance. Each rating table is divided into easy to see efficiency zones. Now you can know without calculation, how efficient the fan you select really is, and there is a constant reminder to select fans in the best zone of operation.

Type BI Fan Catalog ➤
DS-348B
First of three new Trane Catalogs — 88 pages — complete in every detail — write for a free copy now.

A
Type FC Fan Catalog
DS-348F
80 Pages of ready-to-use information on the FC Fan.

Utility Blower Catalog ➤
DS-348U
Separate data on utility blowers contained in this compact booklet.

Multi-Feature Fans

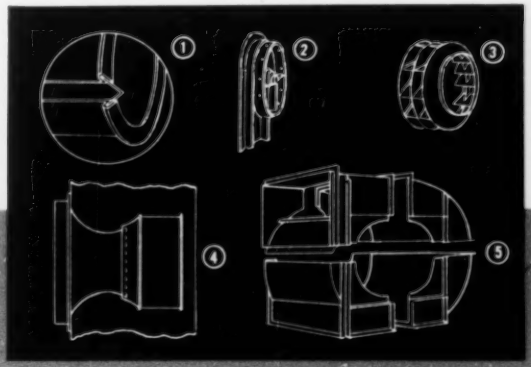
Feature upon feature has been crammed into the new Trane Fan Line. Trane Fans are finished in clorinated rubber base enamel for corrosion resistance — an exclusive feature. Other features include low horsepower, low noise level, and minimum outlet velocity. Literature is the most complete in the industry. Contact your nearest Trane Sales Office for complete information on the new Trane Fan Line and learn why Trane Fans are superior to any other fan line.

New Duct Calculator

To make fan application even easier Trane engineers have perfected an entirely new duct calculator. Direct readings, from *one* setting. This new calculator is available through The Trane Educational Division at a non-profit price of $1.00 each.

CONSTRUCTION FEATURES

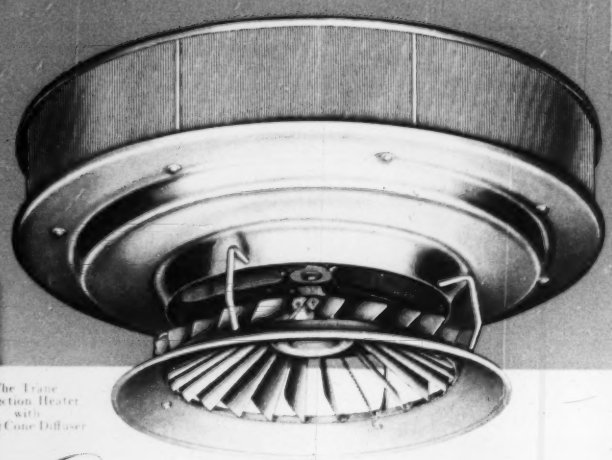
1. Lock seam construction on all smaller units prevents air leakage. Larger sizes have all-welded construction for air tightness and greater strength.
2. Uninterrupted inlet collar on all fan sizes simplifies duct connection.
3. Stiffening rings provide extra rigidity to the wheel where size of fan and kind of duty require it.
4. Streamlined inlets scientifically designed to increase fan efficiency and produce exceptionally quiet operation.
5. Split housings make it possible to disassemble larger fan housings in horizontal and vertical sections.



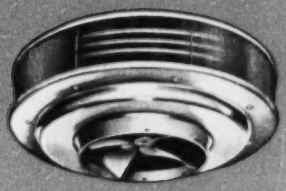
THE TRANE COMPANY LA CROSSE, WISCONSIN

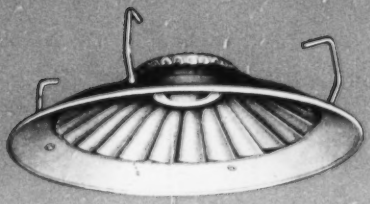
MANUFACTURING ENGINEERS OF HEATING AND AIR CONDITIONING EQUIPMENT • OFFICES IN 80 CITIES

TRANE *Presents...*



The Trane Projection Heater with Louver Cone Diffuser





Above: Projection Heater without diffuser.
Below: Louver Cone Diffuser.

A new ATTRACTIVE PROJECTION HEATER PLUS A NEW DIFFUSER THAT IS COMPLETELY ADJUSTABLE

Now the Projection Unit Heater — the unit originally introduced by Trane — has been succeeded by a completely new model. The new 1950 Projection Heater has even more features than its history-making predecessor.

Big feature is a new attractiveness that makes the unit ideal for commercial as well as industrial application. The bottom plate has been given new, graceful yet strength-producing lines. The top has been streamlined for neater appearance, greater strength and simpler suspension.

Among its many other new features are — 1. Coil expanded hydraulically at pressures exceeding 3000 pounds guarantees against coil leakage. 2. New coil for more heat per pound of metal. 3. Motor removable from the bottom in larger sizes for easier maintenance.

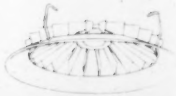
New Adjustable Diffuser

To make the Projection Heater even more versatile and to solve on-the-job diffusion problems easily, Trane engineers have developed a remarkable new diffuser — the Louver Cone. It's attractive and positive in its action. But more important — it's completely adjustable. Now, a projection heater can be installed and then adjusted to meet exactly every requirement. Once installed the heater can be adjusted easily to meet any changes in the building arrangement.

When blades of cone are wide open, increased velocity increases distance of vertical discharge as much as 60%. With cone blades closed, warmed air is spread over an extremely wide area. Any point between these extremes easily results from simple adjustment of the blades.

Close the blades completely and the diffuser forms a cone for low ceiling mounting.

Only a touch of the fingers is required to adjust the individual blades.



By varying the pitch of the louvers the air can be directed to any angle — some of it straight down, the balance in a wide half circle.

THE TRANE COMPANY . . . LA CROSSE, WIS.
EASTERN MANUFACTURING DIVISION, SCRANTON, PA.
Manufacturing Engineers of Heating, Ventilating and Air Conditioning Equipment—Unit Heaters, Convector-radiators, Heating and Cooling Coils, Fans, Compressors, Air Conditioners, Unit Ventilators, Special Heat Exchange Equipment, Steam and Hot Water Heating Specialties.
IN CANADA, TRANE COMPANY OF CANADA, LTD., TORONTO

FOUR NEW PRODUCTS

ABOVE ARE ANNOUNCEMENTS OF TWO OF FOUR GREAT NEW TRANE PRODUCTS. INFORMATION ABOUT NEW TRANE FANS AND NEW TRANE GAS UNIT HEATERS APPEARS ON PRECEDING PAGES.

MANUFACTURING ENGINEERS OF HEATING AND AIR CONDITIONING EQUIPMENT • OFFICES IN 80 CITIES

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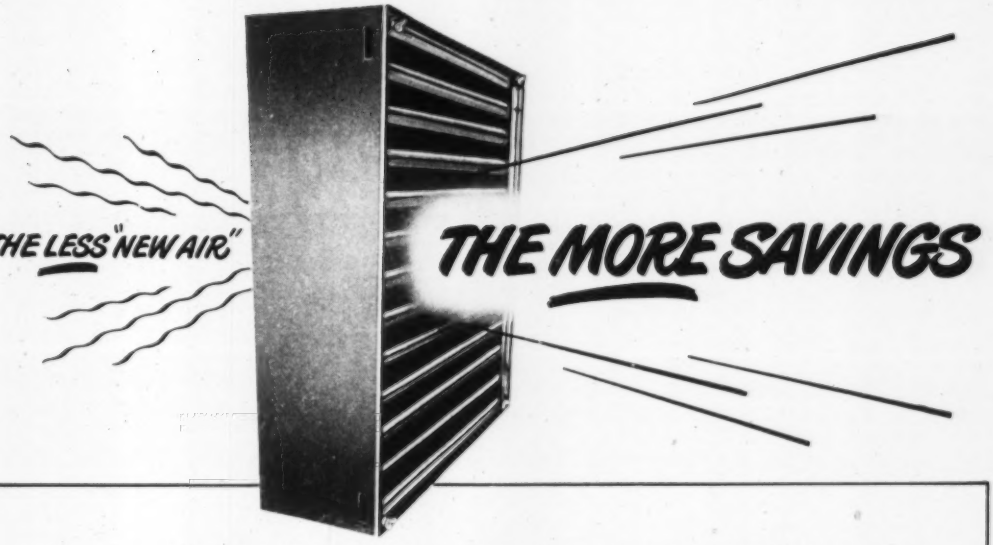

OVER 6,000 USERS

Save Millions

WITH

DOREX AIR RECOVERY

With Dorex C Cells in an air conditioning system, the volume of new, outside air that must be taken in can be reduced by as much as two-thirds. Thus, cost of original equipment and operating costs are both materially lower.

These facts are of great importance to economy-minded industry today.

It costs over $200 a year to condition every thousand cubic feet of new air circulated per minute. But Dorex Air Recovery "manufactures" fresh air for less than half this cost. Dorex Air Recovery is backed by more than 20 years of experience . . . the biggest names in American business are Dorex users. With Dorex Air Recovery you have more to offer your clients.

Get the complete story of Dorex Air Recovery—technical details, actual savings made, list of users. Write today for Bulletin 117-C.

DOREX
Air Recovery

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114 East 32nd Street, New York 16, N. Y.
Air Diffusion • Air Purification • Air Recovery
In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

W. B. CONNOR ENGINEERING CORP.
Dept. A-50, 114 East 32nd Street, New York 16, N. Y.

Please send me, without obligation, full information on Dorex Air Recovery.

Name .....
Position .....
Company .....
Street .....
City ..... Zone ..... State .....

The Finest, Most Complete Line of Gas Conversion

Improved Telescoping Venturi

New Patented Safety Pilot

New Electrofyre Lighter

New Simplicity and Compactness

One Model Meets 75,000 to 325,000 Btu/hr Requirements

New Combination Fuel Control Valve

New Streamlined, Colorful Styling

Simplified Installation, Service and Adjustment

OFFERING GREATER SALES APPEAL THAN Ever!

Most heating dealers will agree that "Janitrol is Easier to Sell than Sell Against". This has been *true* even though, frankly, some Janitrol Conversion Burners while supplying complete *satisfaction* did not have eye-appeal. With the new DeLuxe model, Janitrol dealers will have a burner that *looks* like the most advanced-design burner, which it *is* by any comparison you care to make. It's a package so *easily* demonstrated, with features so *easy* for prospects to appreciate . . . that we can emphatically repeat "Janitrol is easier to sell than sell against".

Only with the DeLuxe Janitrol can you offer such a combination of features including: Electrofyre remote lighting, improved flame retention burners, new exclusive Janitrol automatic pilot, amazing, new, exclusive combination fuel valve. With only five moving parts —*no* gears, *no* noise, *nothing* to stick or get out of line.

Just as important to the dealer as any of the outstanding features . . . *one model will meet all requirements from 75,000 to 325,000 Btu/hr.* simplifying *all problems* of stocking different size units.

Janitrol dealers are backed by the most comprehensive, and aggressive sales promotion and advertising programs in the entire heating industry. Every practical type of sales help including sales training is yours when you line up with the Janitrol line.

THE NEW DELUXE MODELS

THE NEW CHALLENGER MODELS

THE NEW LARGE CAPACITY MODELS

THE NEW DYNETIC POWER PACKAGES

BURNERS *Ever Built!*

Janitrol

CLIMAXING 30 YEARS OF OUTSTANDING ENGINEERING LEADERSHIP

Twenty-four years ago, Surface Combustion marketed the *first* completely packaged, fully automatic, safety controlled gas conversion burner.

Ever since, Janitrol equipment has *lead* the field in advanced design, *always* with the *dealer* in mind to simplify installation, service and maintenance work.

Now, with the most complete line of gas conversion burners to carry the famous Janitrol nameplate, dealers will have complete Janitrol heating packages to meet any heating requirement from 50,000 up to 3,200,000 Btu/hr.

The star performer of the four lines of new burners . . . the DeLuxe Model JD-05, has many new, exclusive features that will quickly earn even greater public acceptance than previous Janitrol models that have built an unrivaled record of time-proven performance.

Only when you lift the attractive blue and gray, chromium trimmed burner cover, will you realize how new improvements have made other burners obsolete by comparison.

Imagine a control assembly of 33 parts doing a better job than a unit with 279 parts . . . that's just part of the story of Janitrol's advanced design.

To fully appreciate the great value and the increased sales appeal of the finest built, most complete line of Janitrol Gas Conversion Burners, get in touch with your local Janitrol representative or write direct to Surface Combustion Corporation, Toledo, Ohio.

With Janitrol You Offer More... You Profit More!

THE NEW CHALLENGER

MODEL JF-05

Although the new Janitrol Challenger does not offer all the new features that are standard with the DeLuxe Series, it is more than a match for competitive lower cost equipment. The Challenger is typical of all Janitrol equipment, easy to install and service using control and combustion principles thoroughly proven in many thousands of homes. With the Challenger, Janitrol dealers are well equipped to meet any type of competition.

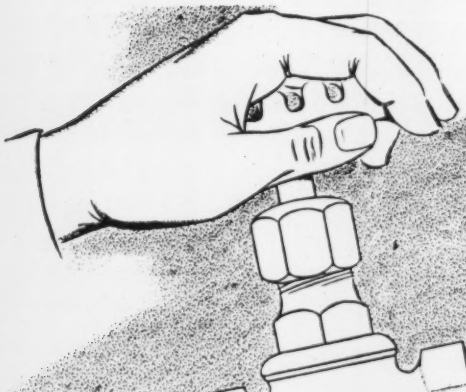
JANITROL SERIES SC-05

Two models meet any requirement from 325,000 to 750,000 Btu/hr. Units are complete, factory assembled packages, designed for easy installation and full accessibility. Optional equipment includes instantaneous flame failure protection with complete control panel to meet local gas company, city, underwriters or insurance requirements.

DYNETIC POWER BURNERS

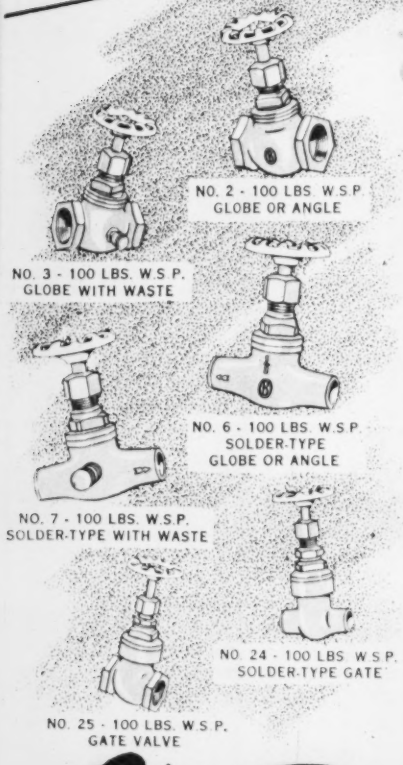
Complete factory assembled including electronic control panel with tattle-tale lighting. Units for all applications from 800,000 to 3,200,000 Btu / hr. Advanced design utilizes 100% primary air, assures ease of adaption, service and low noise level.

SURFACE COMBUSTION CORPORATION, TOLEDO, OHIO



A valve that operates twice a year

Has to be Good!


NO. 2 - 100 LBS. W.S.P.
GLOBE OR ANGLE
NO. 3 - 100 LBS. W.S.P.
GLOBE WITH WASTE
NO. 6 - 100 LBS. W.S.P.
SOLDER-TYPE
GLOBE OR ANGLE
NO. 7 - 100 LBS. W.S.P.
SOLDER-TYPE WITH WASTE
NO. 24 - 100 LBS. W.S.P.
SOLDER-TYPE GATE
NO. 25 - 100 LBS. W.S.P.
GATE VALVE

Most household valves are closed only once or twice a year—some even less. But this infrequent operation can be tougher on valves than the normal wear of valves used more often. On most valves left standing idle, the packing dries out and cracks, allowing water to leak through. The fibre discs in some valves often warp or come apart so that positive shutoff is impossible.

Be assured of a valve that can stand both the wear of frequent operation and the deterioration of long periods of idleness—install O-B valves instead of just any valve.

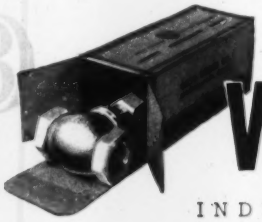
O-B valves are equipped with graphite-impregnated asbestos packing, which remains soft and pliable and resistant to leakage even when idle for several years. This packing is reinforced with lead and copper inserts for strength and long life.

Discs, too, are of the finest quality composition. On all cold or hot water plumbing and heating valves, O-B uses the same disc normally used on steam service—an extra precaution against warping or splitting, so common with the fibre discs used in many other valves.

A full line of plumbing and heating valves are stocked by your local O-B distributor. See him for your valve needs.

OHIO BRASS COMPANY, MANSFIELD 2 OHIO

4024-V

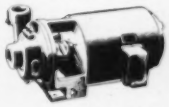


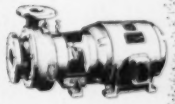
Ohio Brass VALVES

FOR DOMESTIC AND INDUSTRIAL USE

ALLIS-CHALMERS
PACKAGE PUMPS

SSR Fractional hp.


Electrifugal 1 to 10 hp.


SSU 10 to 125 hp.

Plenty of room for maintenance

LOOK AT THE SPACE between the pump and motor on this *Electrifugal* pump. Packing maintenance or replacement is quick and easy, yet rigidity of the frame has not been sacrificed. You save time and money on maintenance. You get a better packing job because your maintenance man has room to work.

Maintenance procedures on bearings have been eliminated altogether. Bearings are sealed with just the right amount of the correct grease. They cannot be over or under lubricated. Bearings are protected from liquid by a new type of double bearing seal that excludes all liquid under any normal operating condition.

All cast iron frame construction for rigidity and corrosion resistance... smooth contours for pleasing appearance and easy cleaning . . . replaceable wearing rings . . . shaft sleeves . . . are other high quality features that make A-C package pumps deliver low cost per gallon pumped.

COORDINATED DESIGN

Pumps and motors are designed, built, assembled and tested in the same plant to work together to give you more for your pump dollar. Competent application engineers help you select exactly the right pump for your needs and a nation-wide network of Certified Service Shops helps you keep your pumps in top condition.

Get details on the cost cutting A-C Package Pump for your application from your A-C Authorized Dealer or Sales Office. Or write for Bulletin 52B6140. A-3062

ALLIS-CHALMERS, 1171A SO. 70 ST. MILWAUKEE, WIS.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

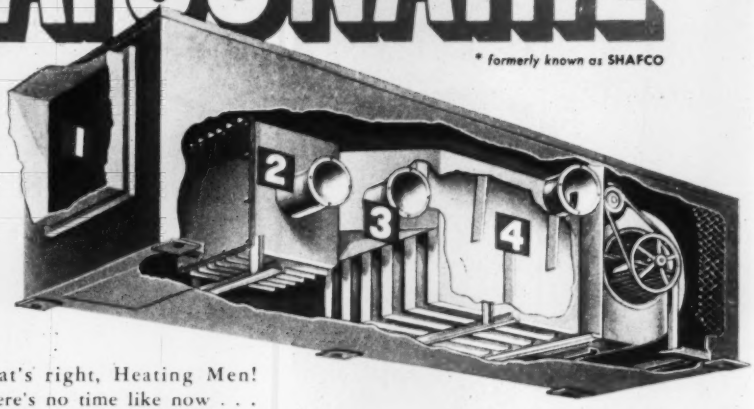
Texrope, Vari-Pitch and *Electrifugal* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

NOW'S THE TIME TO "TIE IN" WITH

SHAFCONAIRE*

* formerly known as SHAFCO



Leader in the Overhead Oil-Fired Heating Market

That's right, Heating Men! There's no time like now . . . *right now* to get set with SHAFCONAIRE OverHead Heaters. They're big business boosters, extra profit producers. For SHAFCONAIRE, you know, is the original suspended oil-fired furnace known for years as SHAFCO. It's quality-built from end to end . . . designed especially for use in commercial and industrial buildings. Not just a domestic floor-type unit tilted horizontally on its side. And SHAFCONAIRE has been time-tested, thoroughly proved in use . . . the only furnace of its type backed by over 12 years actual operation in the field.

MODELS from 100,000 to 405,000 B.T.U. for single or multiple unit installation to meet a wide range of commercial and industrial heating requirements.

OVERHEAD HEATERS, INC.

(formerly SHAFCO Distributing Corporation)

1354 BOOK BUILDING • DETROIT 26, MICHIGAN

And here's something to talk about

4 ESSENTIAL FEATURES FOUND ONLY IN SHAFCONAIRE

1. BUILT-IN PLENUM CHAMBER—An exclusive patented feature that saves you plenty of time, trouble, and guess-work in making installations. Assures uniformly heated warm air output, eliminates on-the-job sizing and extra sheet metal work. Just top off ducts from end, top or both sides to meet installation requirements.

2. HEAVY DUTY CONSTRUCTION—Use of heavy gauge welded boiler plate assures long-life, trouble-free operation. No warping, no buckling, no burn-outs common to stamped steel construction.

3. INTERMEDIATE HEAT-TRAVEL SECTION—Patented intermediate chamber between refractory-lined firebox and heavy gauge heat exchangers serves to spread flame and eliminate impingement on metal. Permits expansion of hot gases, improves operating efficiency.

4. EFFICIENCY ENGINEERED HEAT EXCHANGER—Alternately spaced baffle plates in each of the heat exchanger sections effectively retard the flow of hot gases toward stack connection, permit maximum transfer of heat.

OVERHEAD HEATERS, INC.
1354 BOOK BUILDING • DETROIT 26, MICHIGAN

Please send me complete information and Price Lists on SHAFCONAIRE (formerly SHAFCO) OverHead Heaters.

*Name*_____

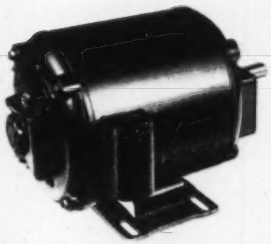
*Company*_____

*Address*_____

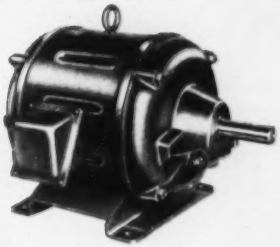
*City*_____ *Zone*_____ *State*_____

DON'T DELAY!
SEND COUPON TODAY!

You'll get complete details and price information on the "hottest" bet for extra profits in the present heating market.

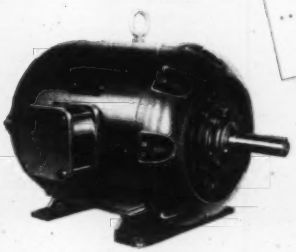


Repulsion Start Induction Motor
⅛ to 15 hp.

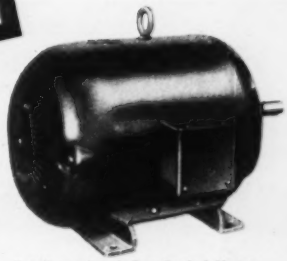


Open-type, Polyphase Squirrel Cage Motor
⅛ to 400 hp.

WAGNER MOTORS
....The choice of leaders in industry



Explosion-Proof Motor
½ to 200 hp.



Totally-enclosed, Fan Cooled Motor
1½ to 200 hp.

When You *Standardize* on Wagner Motors . . .
You Standardize on *Quality!*

Give an added selling point to your product by standardizing on Wagner Motors. Their high quality and steadfast dependability have made them the first choice of many manufacturers and industrial plants. If you need motors that will give troublefree service and build customer satisfaction choose Wagner Motors.

Regardless of what your motor requirements may be, Wagner can furnish a standard motor to fit your needs. Twenty-nine branch offices, located in principal cities, are ready to help you. Write for Bulletin MU-185 for information on the complete line of Wagner Motors.

You'll Save Time. Money. Worry. Because:

- Wagner Motors are immediately available from Wagner Branches in principal cities.
- Improved engineering features assure long life and efficient operation.
- Wagner Motors are backed by a liberal warranty.
- They are available in a wide range of types and sizes for every application.
- More than 450 Wagner Authorized Service Stations and Parts Distributors *plus* 25 Wagner-owned Service Branches provide on-the-spot service, genuine repair parts, or replacement motors.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

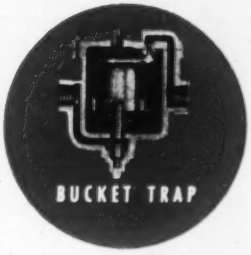
BRANCHES IN 29 PRINCIPAL CITIES

679 SARCOS

WILL INSURE EFFICIENT HEATING IN NEW FORD BUFFALO PLANT

The new Ford pressed steel plant in Buffalo, N. Y., will have a floor area of 1,000,000 square feet and employ 3,500 people. To insure dependable and efficient heating, 327 Sarco Inlet Valves will be used on the hot water radiators; 215 Sarco Float-thermostatic steam traps on unit heaters, ventilators, blast coils and storage heaters, and 137 Sarco bucket traps for dripping and steam lines.

Wherever heat is used—in buildings, large or small—for hot water or any type of steam heating—you will find a chance to save three ways with Sarco. You save production time by having continuous, reliable heat —no cold blasts of air, for instance, when condensate is removed continuously by the Sarco float-thermostatic trap. You save in maintenance because of the well-known long life characteristics of Sarco products. And, you save fuel because a system that is efficient converts every dollar's worth of usable steam into usable heat. Ask for the Sarco bulletins on steam traps and controls for heating systems.



Ask for the Sarco Bulletins on Steam Traps and Controls and Heating Systems

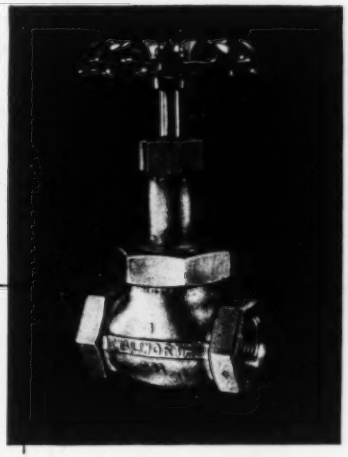
329

SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 8, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

IDENTIFICATION DISC: An aluminum marking plate on all Walworth No. 225P's facilitates inventory control and makes reordering quick and positive.



take a good look at the Walworth "500 Brinell" no. 225P Globe

NEWLY DESIGNED HANDWHEEL: Patented air cooled, finger-fit handwheel affords sure grip even with greasy gloves.

– the Toughest Bronze Valve Your Money Can Buy

The stainless steel, corrosion resistant seats and discs are heat treated to a hardness of 500 Brinell – hard enough to scratch glass and crush nails! The valve can be closed on sand, slag, and pipe scale without injury to the seating surfaces. "Wire drawing" is practically eliminated. All parts are accurately machined and gaged. Years of tight, positive shut-off are assured.

Available in both globe and angle types (angle type: No. 227P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. W.S.P. at 550 F, and 1000 lbs. non-shock service on cold water, oil, gas, or air.

For full data on this long-life, economical Walworth Bronze Valve, see your local Walworth distributor, or write for Circular.

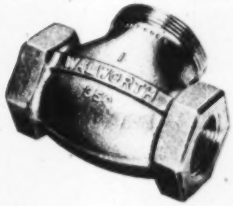
IMPROVED PACKING: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure when fully opened.

note these 7 Great Features

HEXAGONAL UNION BONNET CONNECTION, DEEP STUFFING BOX AND RUGGED STUFFING NUT: Union bonnet connection eliminates any chance of distortion or leakage even though valve is repeatedly taken apart and reassembled.

OVERSIZE STEM: The high-tensile strength silicon-bronze stem assures long life and protection against wear.

SEATS AND DISCS: Plug type seats and discs of stainless steel, heat treated to 500 Brinell hardness and machined simultaneously to a mirror-like finish, with accurate tapers assures tight positive shut-off with minimum handwheel effort.



EXTRA STRONG BODY: Made of Composition M (ASTM B61) bronze. Thick walls and rugged hexes provide a high safety factor. Valves undergo hydrostatic shell test of 1,000 psi.

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

DEPENDABILITY

THE TRUE MONEY-SAVER IN EVERY "BUFFALO" PUMP

OLD FAITHFUL GEYSER, spouting 12,000 gallons of scalding water 150 feet into the air every 66½ minutes, has been a byword for DEPENDABILITY to millions of tourists since its discovery in 1870.

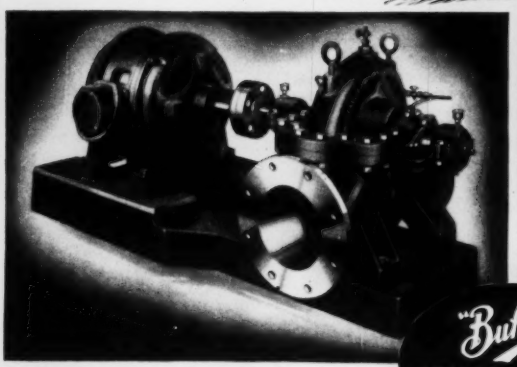
"BUFFALO" PUMPS have an equally strong reputation for dependability with thousands of users. AND THIS MEANS ECONOMY IN EVERY PUMPING JOB! It means freedom from costly repairs—and, more important, freedom from long shutdowns, which are the big cost of pump failure.

Why take a chance? Back up your liquid-moving jobs with "Buffalo" Pumps and enjoy the true economy in this dependability. Call on your nearby "Buffalo" Engineering Representative for complete information.

BUFFALO PUMPS, INC.

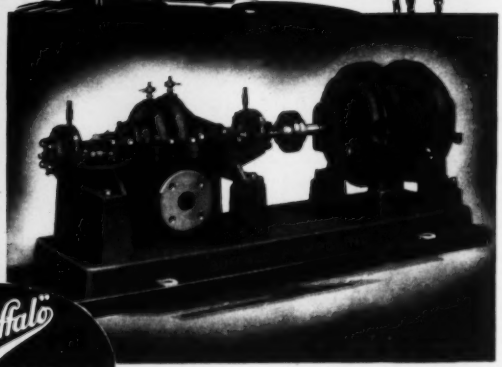
171 Mortimer St., Buffalo, N. Y.
Canada Pumps, Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities



"Buffalo" Class "SL" Pumps are widely used on air conditioning systems and for other clear water service. Write for Bulletin 955-N and see their heavy-duty precision construction.

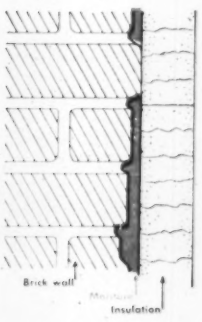
"Buffalo" CENTRIFUGAL PUMPS



"Buffalo" Class "RR" Pumps for boiler feed and general service are popular with users for their efficiency and durability on the job—in models to deliver from 20 to 900 gpm at heads up to 1500 ft. Write for Bulletin 980-B.

What's wrong with this picture?

This picture shows one of the most serious mistakes that can be made in cold room construction. Back plaster has been omitted, and the insulation is being erected directly against a primed brick wall.

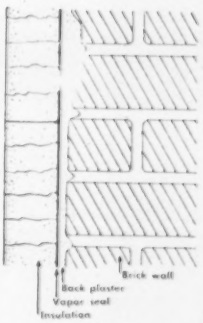


WRONG

When you leave out back plaster, insulation adheres only to the high spots of the irregular wall surface. The bond will be weak. Even more serious, moisture coming through the wall will collect in the hollows behind the insulation. Then it will work its way into the insulation material, and heat will pour through because moisture is a heat conductor. If that moisture freezes, the insulation will bulge from the wall.

These dangers can be avoided by making the wall true and even with back plaster. It fills all voids and hollows, provides a smooth surface for a tight insulation bond, and cuts down air flow. Add a good vapor seal of asphalt paint and hot asphalt and a truly moisture-resistant material, such as Armstrong's Corkboard, and the job will last years longer.

Portland cement back plaster is just one of the things Armstrong engineers recommend to keep moisture out of low-temperature insulation. In almost 50 years in the insulation business, the entire Armstrong organization has learned the answers to the moisture problem. The next time you have an insulation job, take advantage of this knowledge. Call the Armstrong office nearest you or write to Armstrong Cork Company, 4408 Concord St., Lancaster, Penna.



RIGHT

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

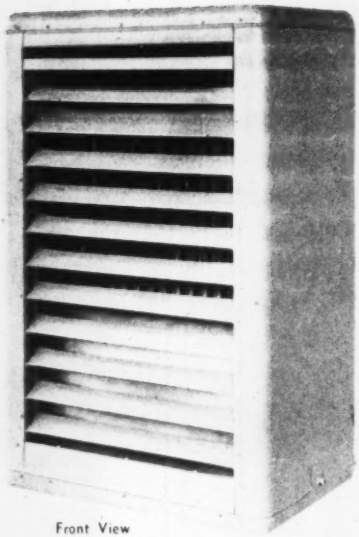
FOR ALL TEMPERATURES FROM 300° F. BELOW ZERO TO 2800° F.

John Zink's New SUSPENDED UNIT HEATER

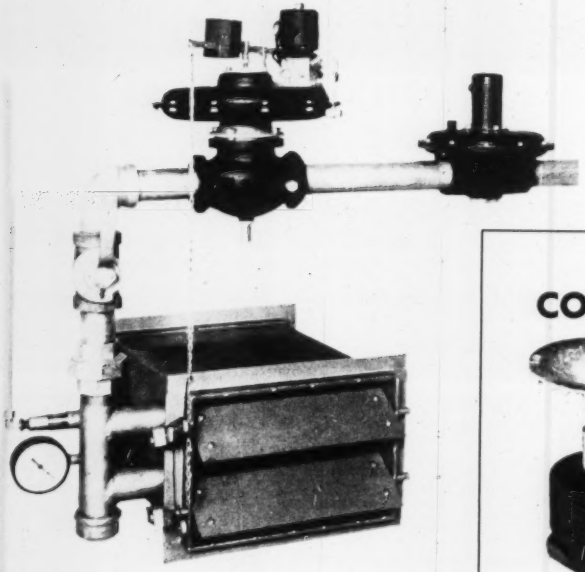
(Series UHS Fan Type)

A.G.A. Approved for Natural, Mixed, Manufactured or LP Gas

For clean, safe, trouble-free heating of industrial and commercial establishments, gas-fired suspended heaters have proven themselves and the New John Zink UHS Gas-fired Suspended Heaters assure customer satisfaction. A complete, packaged unit fully automatic, the heaters are suspended from the ceiling to conserve valuable floor space and yet are designed so that they will be an attractive addition to any shop or store.



Front View



The New Series STV

GAS BURNER

IDEAL FOR HEATING BOILER INSTALLATIONS

—From 1 to 50 Heads—

QUIET - EFFICIENT - ECONOMICAL

BLUE FLAME

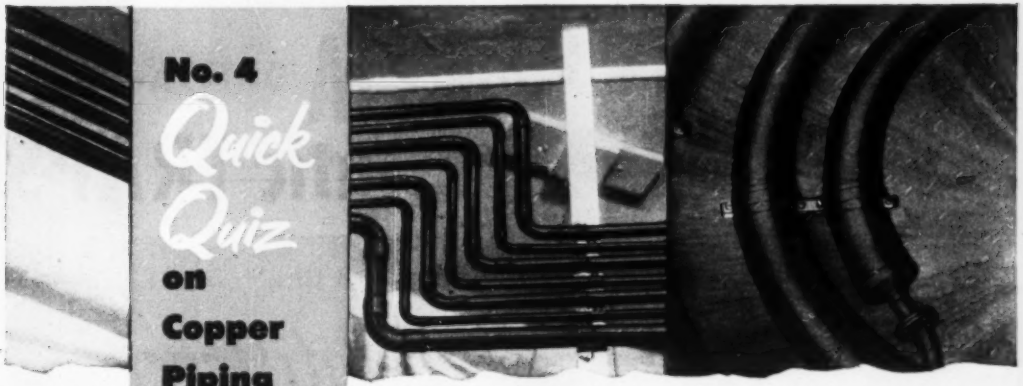
CONVERSION BURNER

This is the John Zink VR-1200 Blue Flame Gas Conversion Burner. Notice that the controls are concealed in a neat, attractive hammer finish cabinet which is easy to keep clean. You have a full automatic burner in a complete packaged unit.

For Natural, Mixed or Manufactured Gas

JOHN ZINK COMPANY

4401 SOUTH PEORIA **TULSA, OKLAHOMA**



No. 4 Quick Quiz on Copper Piping

Q Does copper tubing lose less heat than iron pipe does?

A Yes. Because of its smooth, reflective surface, heat losses from exposed ANACONDA Copper Tubing due to combined convection and radiation are approximately only half as great as the heat loss from a black iron pipe of the same nominal size.

Q Why is copper tube better for carrying refrigerants?

A ANACONDA Copper Refrigeration Tubing cannot rust and is not attacked by freon or methyl chloride; there is less danger of scale forming and clogging tubing or valves; and leakproof connections are easier to make with copper tubing.

Q Is there more or less danger of bacteria and fungi propagating in copper tubing?

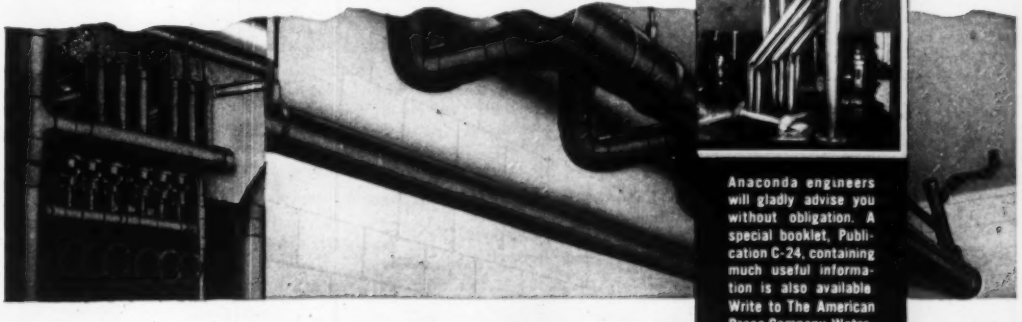
A Less, because the smooth interior and absence of pockets in ANACONDA Copper Tube and Fittings offer less opportunity for lodgement and development of bacteria and fungi.

Q What other undesirable accretions or deposits are prevented or minimized in copper tubing?

A There are many: paper slime, beer stone and milk stone are examples of troublesome industrial deposits in piping which are prevented or minimized in ANACONDA Copper Tube.

Q How can I get advice on copper tubing for my application?

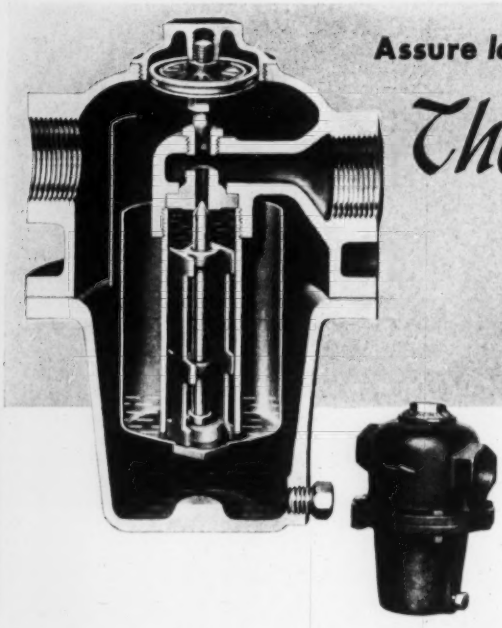
A



Anaconda engineers will gladly advise you without obligation. A special booklet, Publication C-24, containing much useful information is also available. Write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

For better Piping...use **ANACONDA®**
COPPER TUBES

ILLINOIS
Float & Thermostatic TRAPS



Assure *lower* return line temperatures

They're different!

–in construction

–in performance

ILLINOIS Float & Thermostatic Traps operate under vacuum with the same high efficiency as under pressure. No more water-logging of mains . . . no more air binding . . . end "morning overload" troubles. The instantaneous action of the condensate valve assures complete drainage of condensate. A separate thermostatically controlled valve vents air continuously in large volume, yet positively prevents loss of steam.

Recommended Applications

Low Pressure Heating Systems, Ventilating Units, Unit Heaters, Pre-Heaters, Re-Heaters, and other Fan System Heat Surface, Large Radiators or Pipe Coils, Hot Water Generators, Drips of Mains and Risers. Draining Coffee Urns, Warming Tables, Pasteurizers, Vacuum Pans, Heat Exchangers, Process Heaters, Sterilizers, Autoclaves, Cooking Kettles, Kilns and similar equipment.

(For operating ranges from 25 inches vacuum to 15 pounds pressure use Series G Traps. For pressures up to 50 pounds use Series MG.)

Rated capacities of various size traps from 200 pounds to 5000 pounds condensate per hour, at 2 pounds differential across the trap.

Positive, Instantaneous Valve Action . . . an Exclusive Feature

The Snap Action of the Condensate Control Valve assures efficient trap operation. The valve is not directly attached to float but is actuated by impact of the dropping float. Valve action is instantaneous whether the trap is handling its maximum capacity or only a trickle of condensate and regardless of variation in pressures. The valve is either wide open or tight shut—never cracked on seat, never hanging in an intermediate position. It is water-sealed at all times. It cannot chatter and is never affected by pulsations in the flow of condensate to the trap.

Simple, Compact, Trouble-proof

No ball floats to puncture or collapse—no toggles, pins, levers or hinges to corrode, stick or bend. Hard, stainless alloy steel renewable valves and seats are used for both condensate and air bypass units. Both valve units are at the top of trap out of dirt and sludge, assuring long life and satisfactory operation without attention. Straight through connections save head room, fittings, trenching, labor, and avoid low hung piping or lifts. Trap is easily opened for inspection without disturbing piping.

TRAP NOT DAMAGED BY FREEZING. Freezing will not harm this trap in any way and it is self-thawing.

Write for Bulletin 34-C

ILLINOIS ENGINEERING COMPANY
INCORPORATED 1900
RACINE AVENUE AT 21ST STREET • CHICAGO 8

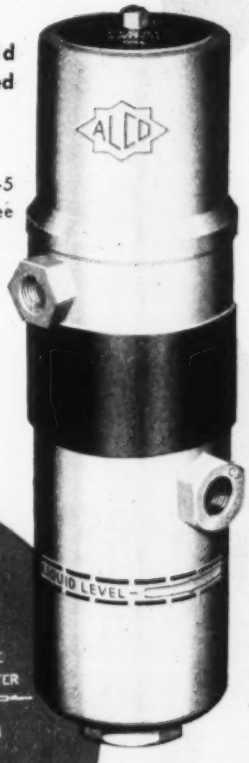
SURE-ACTING ALCO J-5 FLOAT SWITCHES

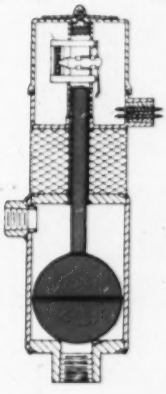
for Ammonia, Freon, Methyl Chloride

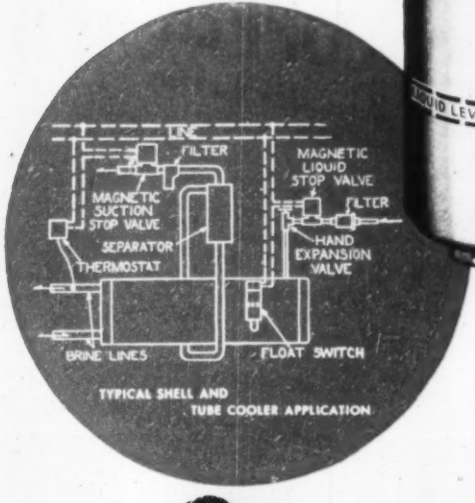
...for more dependable liquid level control on any type of flooded low side

The sturdy simplicity of ALCO Type J-5 Float Switches assures positive, trouble-free action in a wide variety of applications:

- Shell and Tube Coolers
- Single Pipe Surface Coolers
- Direct Expansion Freezers
- High Side Liquid Receivers
- Liquid Sump Pump Controls
- Low Level Alarms







TYPICAL SHELL AND TUBE COOLER APPLICATION

Only two major parts—float chamber assembly and mercury switch relay assembly—separated by 2½" cork insulation to prevent frosting of relay. Differential of ⅝" in liquid level "makes" circuit when level drops, "breaks" circuit when it rises (reverse action also available). Type J-5 Float Switches operate on any voltage or frequency up to 440 v., 60 cy. A. C. or 250 v. D. C. Write for Bulletins 175, 175-1 for full details.

25 YEARS

A QUARTER-CENTURY OF PIONEERING PROGRESS

ALCO VALVE CO.

861 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

SEE YOUR ALCO WHOLESALER

4402

Design for Permanence and LOW PRODUCT COSTS

with

HUSSEY COPPER

AVAILABLE IN SHAPES, SIZES AND GAUGES TO MEET YOUR NEEDS

FOR PERMANENCE . . . Hussey Copper and Brass are the *ageless* metals. With unmatched corrosion resistance as a basic physical characteristic, these metals retain their original beauty for the lifetime of your product.

For Low Product Costs . . . Versatile Hussey Copper and Brass are easy and fast to form and to fabricate. They make possible production time-savings whether the fabrication process is soldering, brazing, riveting, crimping, bolting, screwing or laminating.

Compare . . . and see how Hussey Copper or Brass does your job better . . . and faster.

COPPER HUSSEY BRASS

C. G. HUSSEY & COMPANY

(Division of Copper Range Co.)

ROLLING MILLS AND GENERAL OFFICES

PITTSBURGH 19, PA.

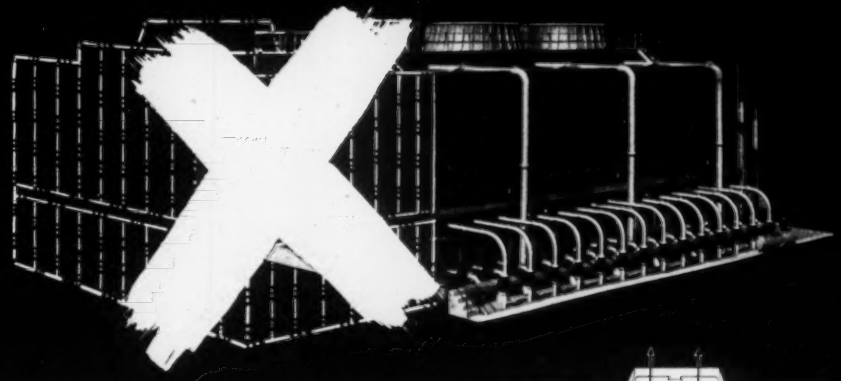
7 Convenient Warehouses to serve you promptly!

PITTSBURGH, 2850 Second Avenue • CLEVELAND, 5318 St. Clair Avenue • NEW YORK, 140 Sixth Avenue • CHICAGO, 3900 N. Elston Avenue • ST. LOUIS, 1630 Delmar Boulevard • PHILADELPHIA, 1632 Fairmount Avenue • CINCINNATI, 434 Commercial Square

Our 102nd year

1848-1950

LOST! One Sale!



Several years ago, one of America's largest pipeline companies installed Marley Double-Flow cooling towers at each compressor station. Recently, an unprecedented demand for natural gas caused each station to be "beefed up" to carry the unexpected heavy load.

A Marley Application Engineer was called in to give his recommendations for enlarging the cooling towers to give the colder water needed to cool the heavily loaded gas coil circuit.

After a complete survey of the water cooling needs, he found that colder water was needed to cool the additional load in the gas coils, but that the compressor engine jacket water cooling circuits and the compressor itself could operate with slightly warmer water.

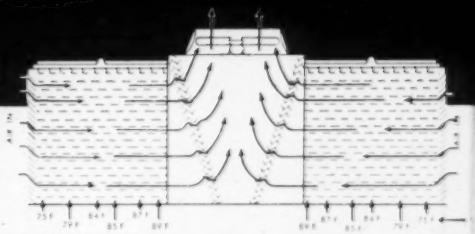
Instead of recommending an extension of each existing Double-Flow, he explained how the Marley Double-Flow cooled from "outside-in" as well as from top to bottom. This results in near-wet bulb temperature water falling in the collecting basin near the louvered side walls.

By installing longitudinal partitions in the cold water basin near the louvered walls, water 7 F to 9 F colder than that specified on the original cooling tower installation could be circulated over the gas coolers . . . and the customer's problem was solved without a capital expenditure.

Yes, MARLEY LOST A SALE—But the customer SAVED MONEY . . . PLENTY OF IT!

This is but one of the many case histories on file proving that Marley "know-how" and Marley Double-Flow cooling towers will do any job better and at less cost. In this case, ONLY A MARLEY DOUBLE-FLOW could have solved the problem. And, ONLY MARLEY DOUBLE-FLOW will give Cross-Flow Water Cooling—an Open Distribution System—Mortise Lock Filling—Low Draft Loss—Marley Mechanical Equipment and other exclusive Marley features. Truly, TOMORROW'S COOLING TOWER IS HERE TODAY . . . at MARLEY!

Get more for your money . . . Save time . . . Save trouble. Ask a Marley Application Engineer to work with you, from the "blue-print" stage on. He'll help you solve your problem without cost or obligation.



Typical water temperatures in a Double-Flow tower just before water enters the cold water basin. Temperature of water in cold water basin is 86 F.

The cross-flow of dry air entering the Double-Flow tower through the entire height of the louvered side wall cools water in this area to almost wet bulb temperature. Water in a cross-flow tower is cooled from outside-inside as well as from top to bottom.

MAIL THIS COUPON TODAY

The Marley Company, Inc., Kansas City 15, Kansas

☐ Please send FREE copy of "What's Your Cooling Tower I.Q.?" Illustrated folders available on Cooling Tower Operation, Maintenance, Water Treatment, Testing, Specifications.

☐ Send Double-Flow Bulletin DF-50.

☐ Have Marley Application Engineer call. HP-5

Name _____ Title _____

Address _____

City _____ Zone _____ State _____

MARLEY

Double-Flow

Vairflo

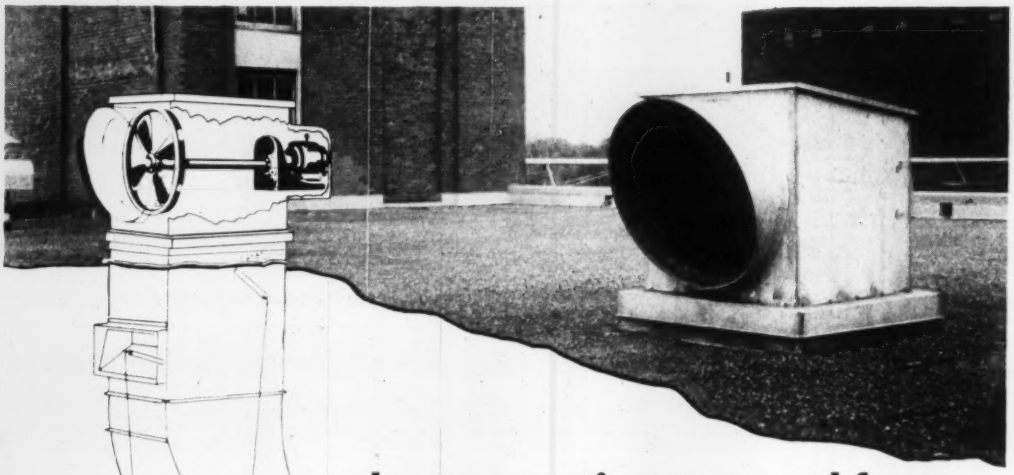
DriCooler

Natural Draft

Counter-Flow

Aquatower

Spray Nozzles



brewery engineers control fumes with PROPELLAIR fans

Alert maintenance engineers at the Hamm Brewing Company, St. Paul, use Propellair Fans to prevent caustic fumes escaping from their bottle-soaking machines. Knowing the harmful effect that condensation of this steaming solution could have on painted walls, Hamm engineers installed Propellair fans on the roof of the bottling house to create a negative pressure on the soaking machines. Propellair engineers recommended the most efficient designs and ratings. These effectively remove the vapors and keep temperatures down on hot summer days.

efficient design

Camber of front and back surfaces produce push-pull action so that Propellair blades create maximum air movement. Blades are designed on the same principle as an airplane wing. Entire blade works, moves air.

propellair is versatile

Propellair is adaptable to any situation. Cools men and machines. Removes dust, dirt, fumes. Saves money, ups efficiency.

Discuss your ventilating problems with experienced Propellair engineers. No obligation.

PROPELLAIR

DIVISION OF ROBBINS & MYERS • INC.

SPRINGFIELD 99 OHIO

new

here's low-cost protection for PRESSURE-LUBRICATED COMPRESSORS

Low lube oil pressure . . . or slow pickup of oil pressure at the start of a cycle can happen in the best of pressure-lubricated refrigeration compressors. And when it does . . . damage to seals and bearings may result. But, you don't have to take this gamble anymore!

Now . . . for the first time . . . you can have life-time protection against such compressor breakdowns with the new PENN Series 275 Oil Protection Control with built-in Time Delay Switch.

Then, when the compressor starts, if the oil pressure does not build up to the proper point within a safe time period, the PENN 275 stops the compressor *automatically* before damage can occur. If oil pressure drops below a safe minimum during the running cycle . . . and does not rise to normal within the time delay period . . . the control shuts off compressor operation.

Thus, the compressor never operates more than the predetermined safe time on subnormal oil pressure. Result? Positive, automatic protection at all times!

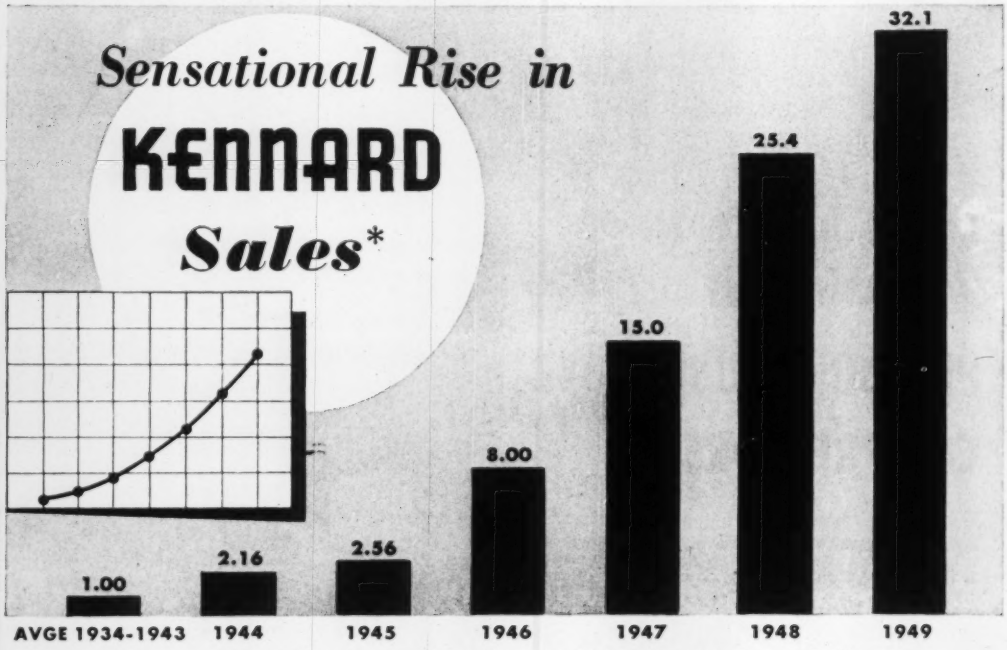
Investigate this new, low-cost protection for refrigeration compressors or for other pressure-lubricated equipment. For complete information ask your compressor manufacturer or wholesaler or write **Penn Electric Switch Co., Goshen, Indiana.** Export Division: 13 E. 40th St., New York 16, U. S. A. In Canada: Penn Controls, Ltd., Toronto, Ont.

PENN

AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES

There MUST be a Reason!



*Taken from sales volume records representing unitary dollar volume.

The old adage "nothing succeeds like success" is proved again. We are giving these facts of Kennard's phenomenal growth not in a boastful vein . . . but because *they mean so much to YOU.*

In the face of a growing "buyers' market" with competition becoming razor keen Kennard shoots ahead in sales! Why? Because KENNARD HIGHER QUALITY plus Dollar Savings is a combination that industry acceptance proves in these figures—represents unbeatable intrinsic VALUES.

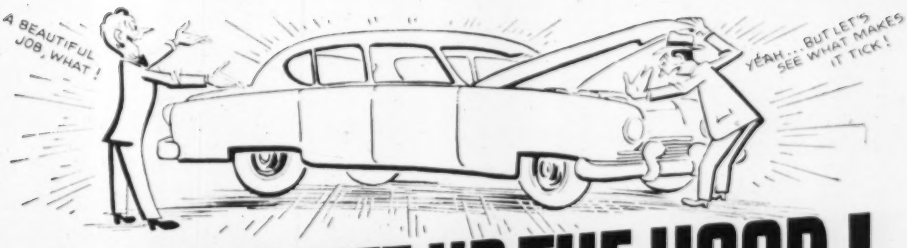
If you are in the market for heat transfer products (Blast Coils, Air Conditioning Units, Evaporative Condensers or Cooling Towers), we invite you to consult with us now—PROMPT DELIVERIES.

Write for Catalogs and Bulletins

No. 47A—FINNED COILS
No. 486—AIR COND. BLOWER UNITS
No. 491—EVAPORATIVE CONDENSERS
No. 494—COOLING TOWERS

Refinement of detail marks the difference between ordinary and excellent.

KENNARD CORPORATION • **1817 S. HANLEY ROAD ST. LOUIS 17, MISSOURI**



IT'S TIME TO LIFT UP THE HOOD!

Nearly twenty years ago, Bell & Gossett Company introduced the B & G Booster—a *horizontal* circulating pump for new forced hot water systems and for modernizing old gravity systems. The horizontal design was selected because it was believed to be the best and most efficient.

This same belief now seems to be universal! Today, most pumps for the same purpose are made as horizontal units—flattering confirmation of our original thinking.

The horizontal design of the B & G Booster is thus no longer a distinguishing feature. So we say, it's time to look a little closer—IT'S TIME TO LIFT UP THE HOOD!

It's time to examine the superiorities of construction which *still* distinguish the B & G Booster. It's time to see its excellence of material, the precision workmanship of its interchangeable parts which enables the B & G Booster to set amazing records for dependability and long service.

Any Booster made since the year 1936 can be serviced with present standard parts—BUT—thousands have been in operation for many years *without need for service of any kind!*

That's why we say, "LOOK UNDER THE HOOD." *See why nearly a million B & G Pumps have been sold to date!*

REMEMBER THIS?

This is the first B & G Booster. Comparison with the streamlined beauty above shows the results of never-satisfied engineering and continual search for improvement.

B & G Hydro-Flo Products include Forced Hot Water Heating System Equipment . . . Water Heaters . . . Heat Exchangers . . . Centrifugal Pumps . . . Refrigeration Condensers and Evaporators.

BELL & GOSSETT *Company*

Dept. BR-5, Morton Grove, Ill.

Canadian Licensee: S. A. Armstrong, Ltd. 1400 O'Connor Drive, Toronto 13

*Reg. U.S. Pat. Off.

A **new** MULTI-PURPOSE UTILITY DRILL

FOR **PLANT MAINTENANCE**

A time-saver and a cost-saver for every plant maintenance crew — the new Gardner-Denver S17 Utility Drill is a full-fledged, self-rotating pneumatic hammer drill that weighs only 19 pounds. It's ideal for placing anchor bolts, for running conduit, cable, pipe, and for many other jobs.

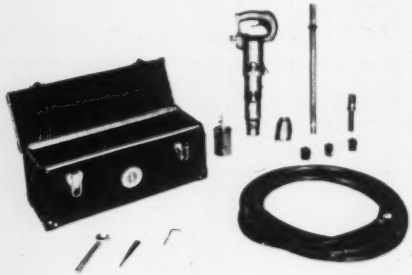
Does a man-sized job — The lightweight S17 does a full day's work — without tiring the operator — thanks to balanced weight and power.

Unusually versatile — Drills concrete, brick or stone — with standard drill steel (7/8" hex. x 3 1/4"). Takes standard star drills — with star drill adapter. Converts to chipping hammer or pick — special feature stops rotation.

Safe and easy to use — Convenient hand-form "D" handle. "Safety First" trigger throttle. Easy hole starting — on partial feed position.

Other big S17 features — Standard 7/8" hex. x 3 1/4" chuck. Trouble-free coil-spring-type steel retainer. Effective lubrication from integral oil chamber. Also available with blower attachment and standard plug drill chuck for dimension stone work.

UTILITY DRILL KIT — IN HANDY CARRYING CASE



Includes complete S17 Utility Drill and accessories: 14" drill steel—three rock bits, sizes 1 1/16", 1 1/8", 1 1/4" — star drill adapter —chuck driver lock pin— drift key — Allen wrench —end wrench—oil can— and 25 feet of 1/4" air hose, with fittings.

Try the new Gardner-Denver Utility Drill today — you'll want one for every maintenance crew in your plant.

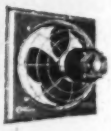
GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., Toronto, Ontario

Since 1859

Since 1889

61 Years of Progress and Development

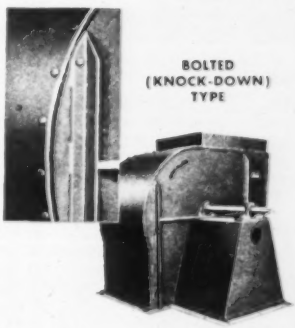


nyb

Type ME Fans Available in Either Welded or Bolted (knocked down) Construction

nyb Fans Class I and II feature ALL WELDED CONSTRUCTION as standard . . . for simplicity, extra strength and rigidity. They are dust tight, leak proof and desirable where building conditions permit. Welded construction may be had in all classes and sizes of *nyb* fans.

Where building openings will not permit the use of welded fans (shipped set up), bolted (knocked down) type is available.



All New York Blower Company products are laboratory tested, accurately rated and fully guaranteed in strict accordance with Standard Test Codes.

Engineering Notes, Bulletin 493 gives full details.

nyb

THE NEW YORK BLOWER COMPANY

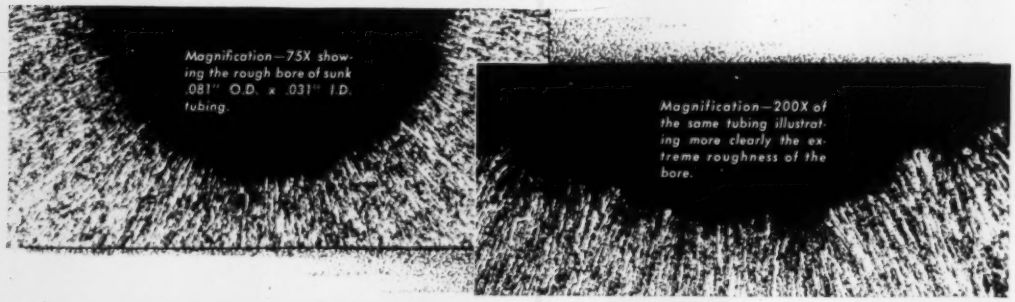
GENERAL OFFICES • 32nd STREET & SHIELDS AVENUE • CHICAGO - 16

FACTORIES AT LAPORTE, INDIANA AND CHICAGO, ILLINOIS

WHICH TUBE WOULD YOU CHOOSE?

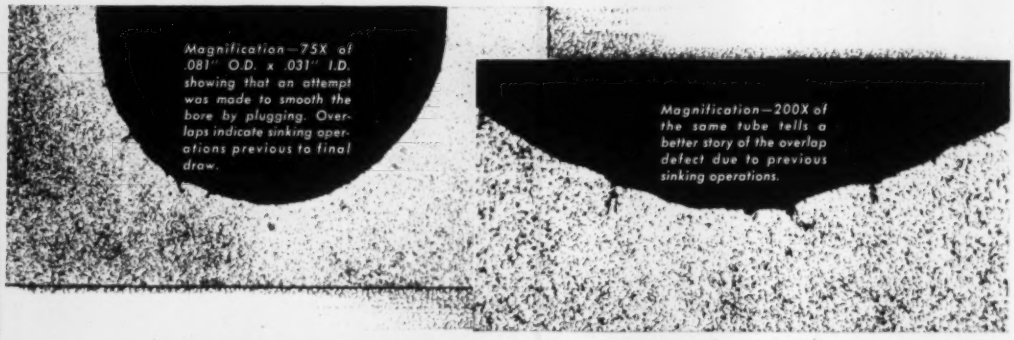
These photomicrographs show the transverse sections of three brands of capillary tubing.

They tell their own stories and prove the truth of our statement that "There IS a difference in tubing."



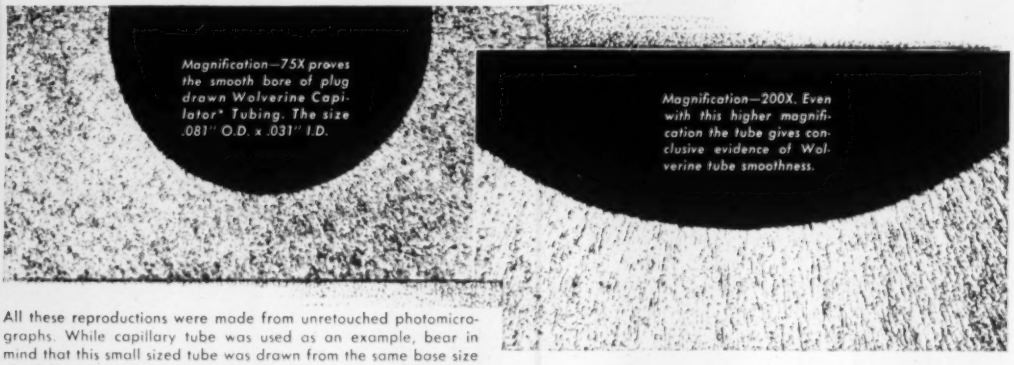
Magnification—75X showing the rough bore of sunk .081" O.D. x .031" I.D. tubing.

Magnification—200X of the same tubing illustrating more clearly the extreme roughness of the bore.



Magnification—75X of .081" O.D. x .031" I.D. showing that an attempt was made to smooth the bore by plugging. Overlaps indicate sinking operations previous to final draw.

Magnification—200X of the same tube tells a better story of the overlap defect due to previous sinking operations.



Magnification—75X proves the smooth bore of plug drawn Wolverine Capilator Tubing. The size .081" O.D. x .031" I.D.*

Magnification—200X. Even with this higher magnification the tube gives conclusive evidence of Wolverine tube smoothness.

All these reproductions were made from unretouched photomicrographs. While capillary tube was used as an example, bear in mind that this small sized tube was drawn from the same base size (3" O.D.) used to produce all other sizes of Wolverine tube. Thus this evidence of quality applies to ALL Wolverine tube, regardless of size.

Which tube would you choose? Of course, you'd choose the tube which would allow the smoothest flow of liquid or gas—and, in the long run, give you the most economical service. You'd choose dependable Wolverine tube.

*Reg. U.S. Patent Office

Let us send you literature telling about the use of tubing in your own applications.

WOLVERINE TUBE DIVISION

Calumet & Hecla Consolidated Copper Company

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MANUFACTURERS OF SEAMLESS, NON-FERROUS TUBING

1419 CENTRAL AVE. • DETROIT 9, MICHIGAN

Plants at Detroit, Mich., and Decatur, Ala.

Stocks Available at All Wolverine Mill Depots:

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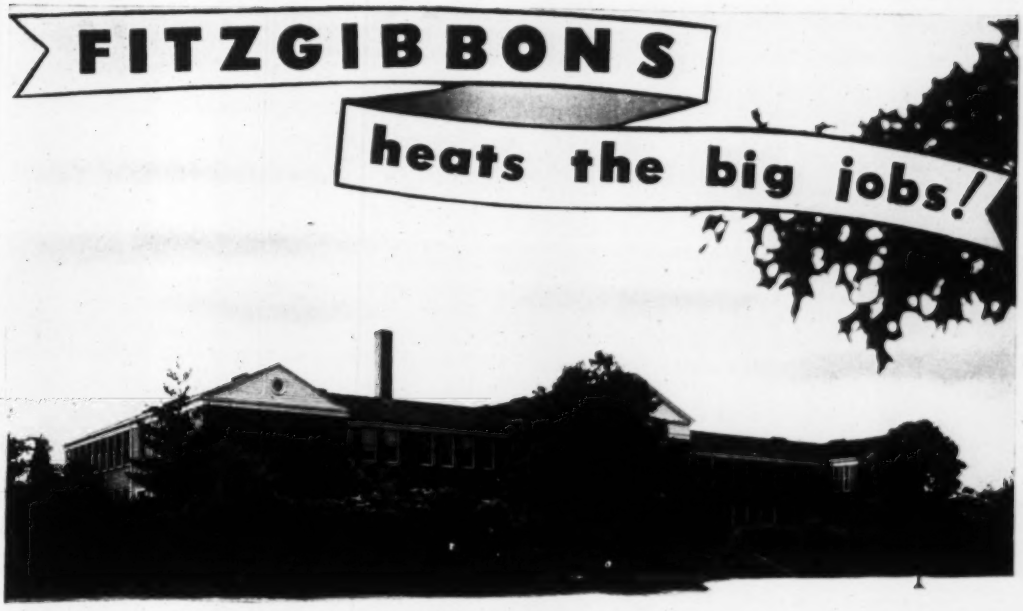
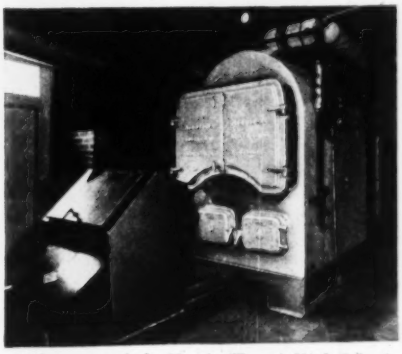
FITZGIBBONS

heats the big jobs!



NORRIS, TENNESSEE, HIGH SCHOOL

A typically fine educational structure



Boiler room of the Norris (Tenn.) High School showing stoker-firing.
Architects: Barber and McMurray, Knoxville, Tenn.
Heating Contractor: John F. Lonas, Knoxville, Tenn.

HEAT BY FITZGIBBONS STEEL BOILERS insures schoolroom comfort at lowest operating cost with any fuel. This stoker-fired installation is effecting great savings for the Anderson County School Board and justifying their confidence in its selection.

Many hundreds of fine school buildings throughout the nation are heated by Fitzgibbons steel boilers.

The best buildings deserve "the best in steel boiler heat"—The Fitzgibbons Boiler.

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Fitzgibbons Boiler Company, Inc.

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Send me the "D" TYPE Boiler Catalog.

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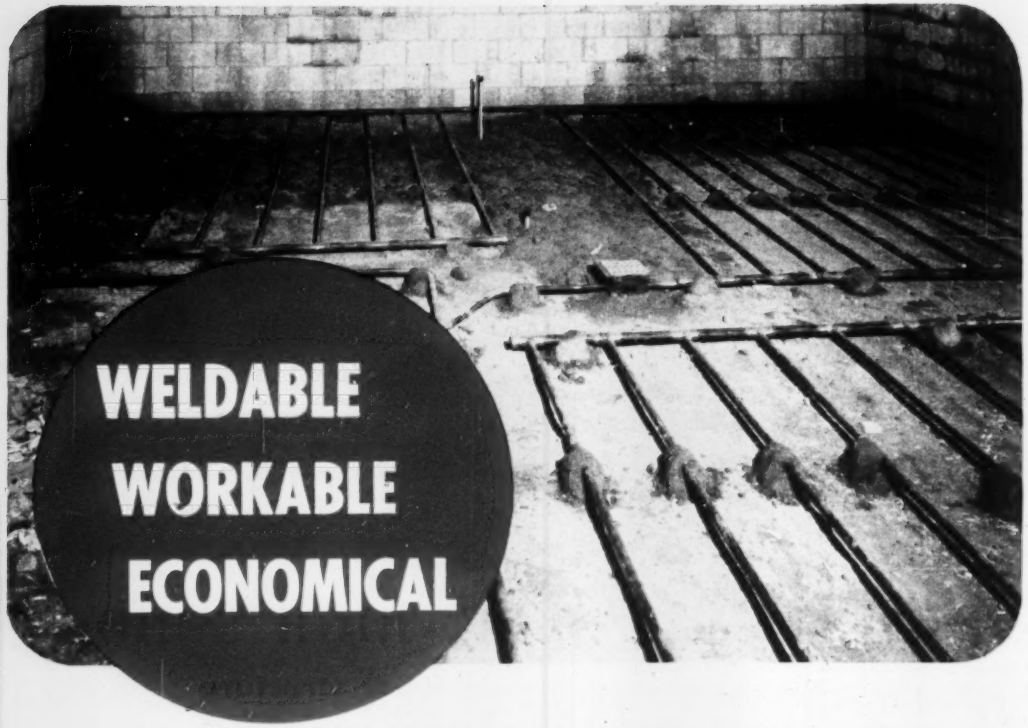
Address:

City: Zone: State:



—for Radiant Heating Panels

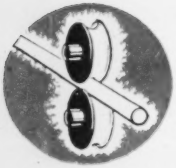
WELDABLE: Republic Steel Pipe wins warm welcomes on radiant heating jobs. Where feeder lines and grids must be joined, this advanced steel pipe welds readily to tight, leak-proof joints by all modern methods. And, it comes to you in long lengths that speed installations by reducing the number of joints.

WORKABLE: Manufactured under Republic's *improved* Continuous Weld Process it is uniform in wall thickness, diameter and concentricity . . . highly ductile . . . suitable for close coiling and bending. With an expansion co-efficient equal to that of concrete and plaster, it is perfectly adaptable to ceiling and sidewall panels as well as floor panels.

ECONOMICAL: Nothing more costly is needed for closed radiant heating systems. That fact has been proved time and again by the remarkably trouble-free record of steel pipe in all closed heating systems. What's more, *today's* Republic Continuous Weld Pipe is even better than that which has served so well over the past twenty years.

Your Republic Pipe Distributor will be glad to give you the latest word on available sizes and current delivery schedules. Check with him soon.

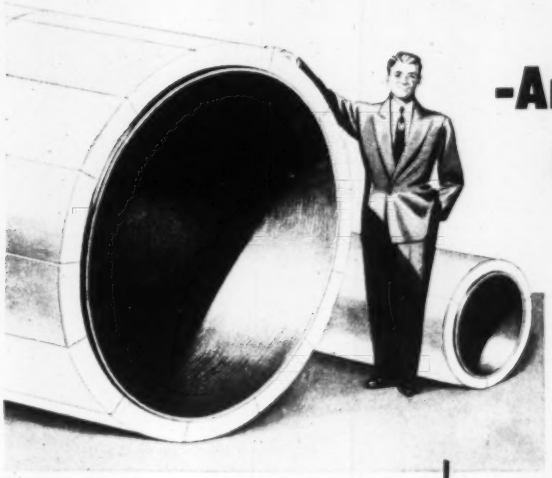
REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Dept.: Chrysler Building, New York 17, N. Y.



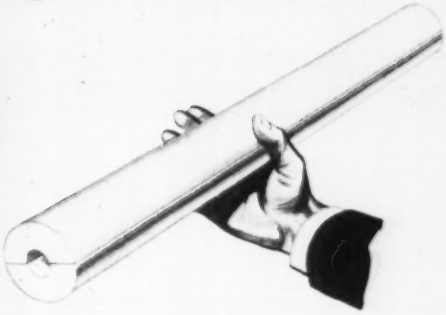
REPUBLIC CONTINUOUS WELD PIPE

Uniformly Strong
Uniformly Ductile
Uniformly Clean and Scale Free
Easy to Weld by All Modern Methods
Easy to Bend, Thread and Close Coil
Economical Uniform Lengths, Extra Long Lengths
Uniform Wall Thickness, Diameter, Concentricity
Expansion Co-efficient Same as Concrete and Plaster

ONE PIPE INSULATION FOR PIPE SIZES ½ TO 72 INCHES



-And Temperatures Up to 1200° F.



SECTIONAL
Pipe sizes from ½" to 12".

TRI-SEGMENTAL
Pipe sizes from 8" to 23".

QUAD-SEGMENTAL
Pipe sizes from 19" to 41".

K-SEGMENTAL
For pipes, vessels or tanks from 38" to 72" in diameter.

KAYLO PIPE INSULATION is produced in Simplified Dimensional Standards of thicknesses, diameters and shapes for snug nesting, when necessary. O. D.'s of insulation correspond to O. D.'s of standard pipes. All sections are 36 inches long. Single-layer thicknesses range from nominal 1" through 4".

Here is one proved pipe insulating material that is efficient throughout a wide temperature range up to 1200°F. Kaylo Pipe Insulation is a calcium-silicate material which is highly resistant to damage from water vapor or moisture. It retains its dimensional stability and efficiency in long service. It is not a glass product.

Kaylo Pipe Insulation is available for pipe sizes from ½ inch to 72 inches. It is made to close dimensional tolerances to assure proper fit for each pipe size and for all operating conditions. Higher strength and lighter weight make it easier to handle and apply.

It will pay you to investigate all of the advantages offered by Kaylo Pipe Insulation. Get the facts now.

KAYLO®

PIPE INSULATION AND HEAT INSULATING BLOCK

OWENS-ILLINOIS GLASS COMPANY
Kaylo Division • Toledo 1, Ohio

SALES OFFICES
Atlanta • Boston • Buffalo • Chicago • Cincinnati • Houston • Minneapolis • New York
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SEND COUPON FOR KAYLO HEAT INSULATION LITERATURE

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Gentlemen: Please send me descriptive literature on Kaylo Heat Insulation.

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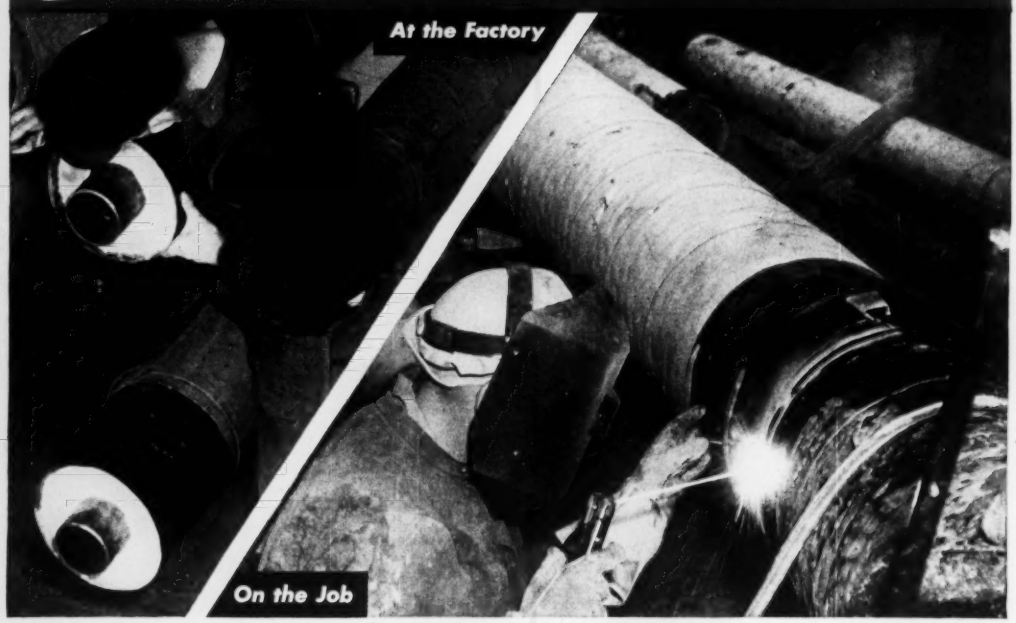

FOR YOUR INSULATED PIPING SYSTEMS

Whether your insulated piping carries steam, hot water, oil, or process liquids, it is given maximum sealed-in protection and efficiency by Ric-wiL Prefabricated Units.

In Ric-wiL HEL-COR Units the piping is insulated with the most efficient material to fit its specific thermal requirements. Both pipe and insulation are housed in a protective 16-gauge helically corrugated ingot iron conduit, hot-dipped galvanized. The outside is given a heavy coating of high-temperature asphalt and is tension-wrapped with asphalt-saturated asbestos felt. The inside is protected with multicoat, baked-on type Phenolic Resin.

The ends of HEL-COR units are sealed at the factory with a heavy ring of insulating cement and special water-repellent packing to give full protection during shipping and installation.

All prefabrication is done in modern factories by skilled workers, using only the finest known protective and insulating materials.

Simple, quick "on the job" field connections may be full-welded and the entire system air-tested for tightness, providing sealed-in protection for long and efficient service.

The Ric-wiL representative nearest you will be glad to show all the advantages of Ric-wiL Prefabricated Piping as applied to your insulated piping problem.

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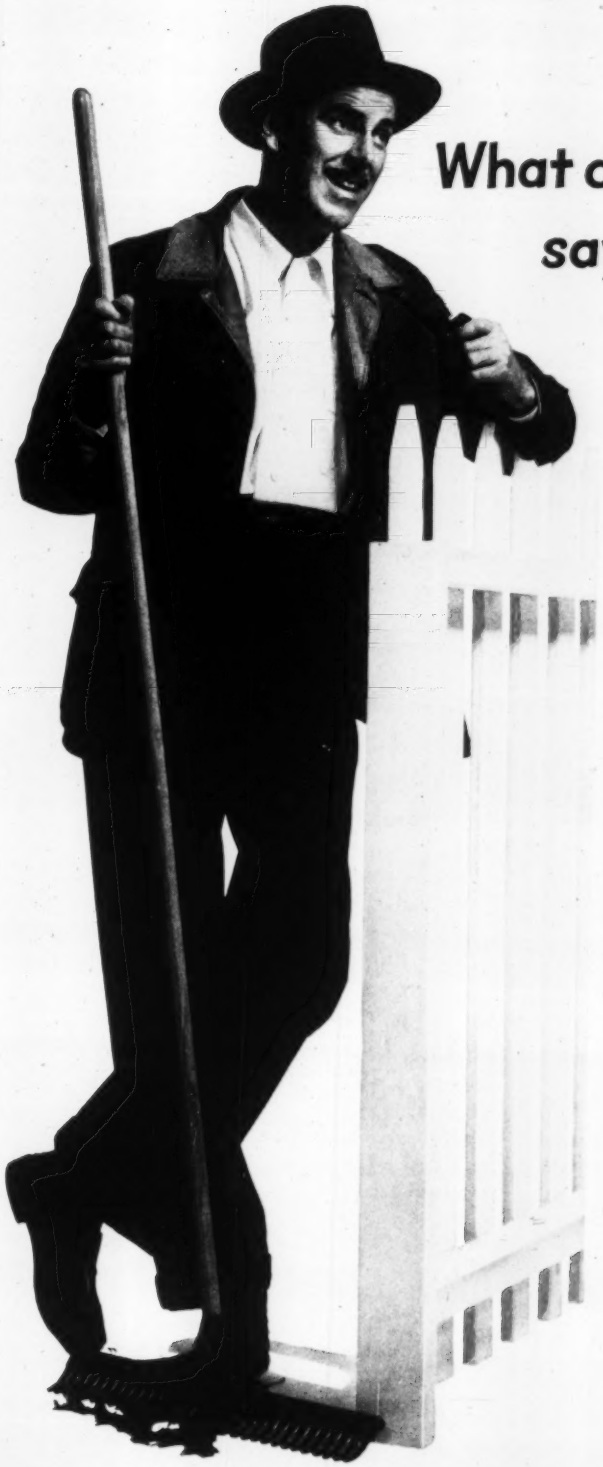
FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS



What do the back fences say about you?

One neighbor tells another. And the contractor who made a commercial or industrial installation of Bryant automatic gas heating always rates high in those confabs . . . usually wins other jobs over the back fences, too!

Customer satisfaction is built into Bryant equipment. It's drawn in by the product designers, kept safe by the finest automatic controls, retained by the heavier construction that assures longer service life. The user is better satisfied . . . more pleased with the contractor who made the sale.

Yes, and Bryant lends a helpful hand in other ways. The Bryant distributor offers a single source for most every type of gas heating equipment. He furnishes valuable engineering assistance, maintains an adequate warehouse stock. He stands ready to work with you on every type of job.

If *you* are interested in having what's said over the back fences mean profitable business for you, it's time to *check with Bryant!*

Let the pup be furnace man ... and water boy, too!

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AUTOMATIC HEATING

The most complete line of gas heating equipment in the nation

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17825 St. Clair, Cleveland, Ohio

( ) Send me the new booklet that tells the Bryant story. ( ) Have your distributor call on me.

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Company

Address

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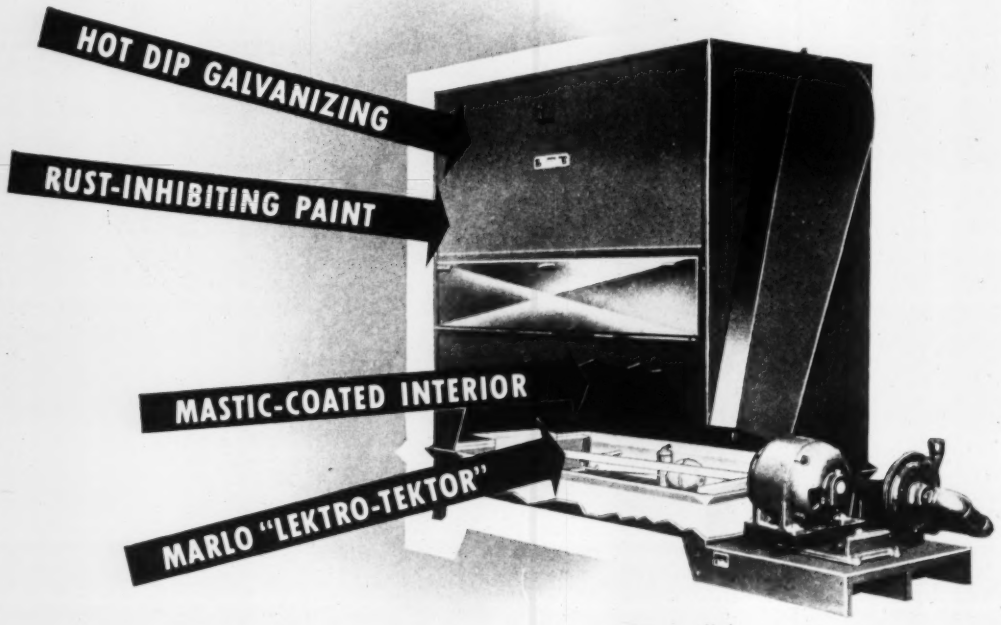
ONLY MARLO COOLING UNITS ARE DOUBLY-PROTECTED AGAINST CORROSION ...Outside and Inside



Marlo
Evaporative Condenser

To assure dependable, longer-lasting installations for you — Marlo Evaporative Condensers and Cooling Towers offer this big four-way defense against corrosion:

Outside—over the Hot Dip Galvanizing—Marlo all-steel housings are sprayed with a special rust-inhibiting alkyd resin-base paint that forms an *extra* front line barrier against corrosive elements.

Inside each unit—sheets, panels and galvanized parts are coated with a sound deadening *asbestos-asphalt mastic* that doubles as an efficient corrosion-retardant. Additional internal protection is afforded by Marlo's exclusive "Lektro-Tektor" that *prevents electrolytic sump tank corrosion.*

MARLO • HEAT TRANSFER
Since 1925

25 YEARS CONTINUOUS LEADERSHIP

Write for complete information on Marlo Evaporative Condensers and Cooling Towers.

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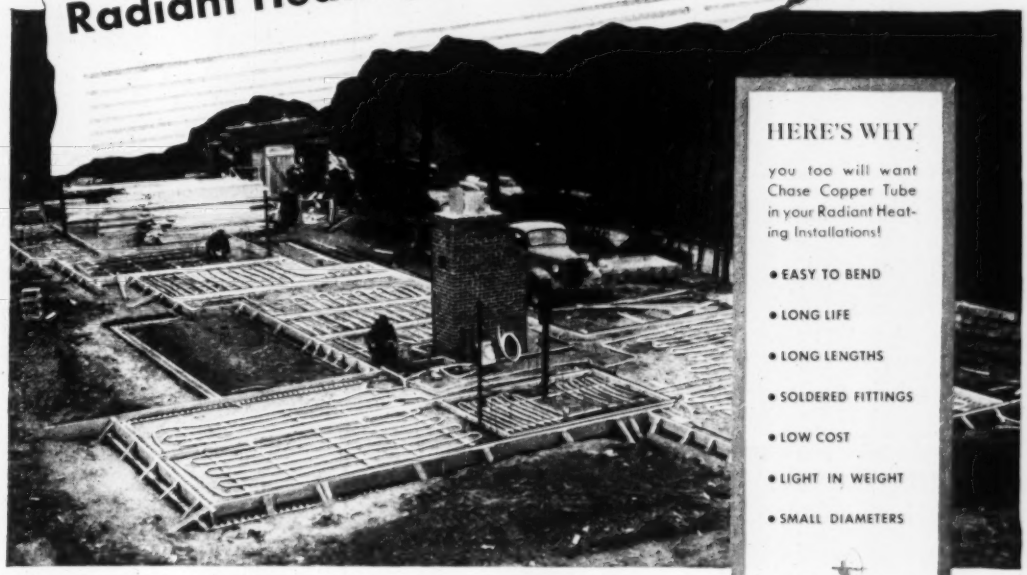
More and More fine Homes get Radiant Heating with Chase Copper Tube!



Coils in this floor installation use 1500 feet of ½" Chase Copper Tube. Architect: Hal W. Greer, Atlanta, Ga. Heating Contractor: Roy Manning, Plumbing & Heating Co., Smyrna, Ga. General Contractor: E. M. Scarborough, Marietta, Ga.

HERE'S WHY

you too will want Chase Copper Tube in your Radiant Heating Installations!

- EASY TO BEND
- LONG LIFE
- LONG LENGTHS
- SOLDERED FITTINGS
- LOW COST
- LIGHT IN WEIGHT
- SMALL DIAMETERS

ARCHITECTS and builders are using *more* radiant heating—and *more* Chase Copper Tube for radiant heating installations—every day!

Why? Chase Copper Tube is flexible, easy to bend by hand, needs no fittings at bends. Its long lengths—60 and 100 feet—cut number of connections. Few needed joints are quickly made with solder-joint fittings.

Chase Copper Tube is light, easy to handle. Its small diameter means ceiling installations without extra plaster depth. Its resistance to corrosion means long service life.

FREE BOOKLET

Just mail the coupon for free book, packed with helpful design information and data tables on radiant heating design.

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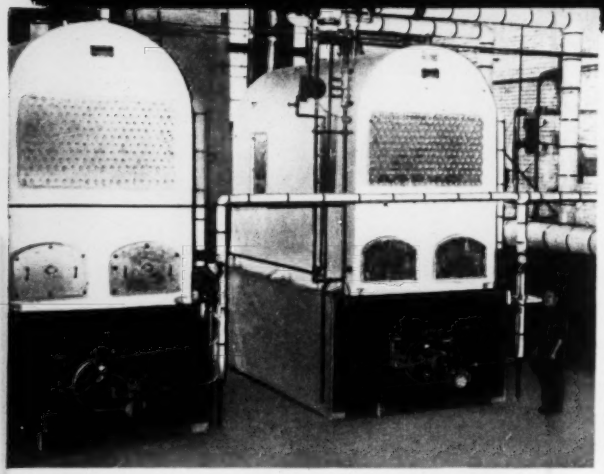


ACE UNIFLOW Oil Burners installed at Studios, Inc., Waltham, Mass.
Two International 250 b.h.p. Boilers
C. T. Main, Inc., Engineers; Seltzer & Co., Inc., Contractors

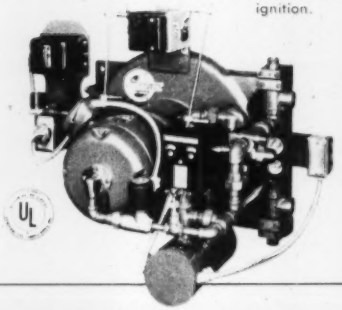
HEATING COST CUT NEARLY 50%!

Mitchell J. Marcus, president of Studios, Inc., furniture manufacturers, heartily testifies to the economy of ACE UNIFLOW Oil Burners. In a letter to Seltzer & Co., Inc., Ace distributor in Boston, Mr. Marcus says, *"With our new ACE UNIFLOW Oil Burners, our heating costs have been reduced 46.5%. With savings such as these, our new system will pay for itself in a very short time."*

TEN SIZES GIVE FOLLOWING RANGE OF CAPACITIES

	Gallons Per Hour	Boiler H. P.	Square Feet Steam Rad.
Minimum	4	12	1,600
Maximum	165	500	66,000

Type DREH fully-automatic, direct drive Ace Uniflow Oil Burner with electric-gas ignition.



Ace UNIFLOW OIL BURNERS ®

"Custom Engineered for Discriminating Buyers"

ARCHITECTS, ENGINEERS, CONTRACTORS . . .

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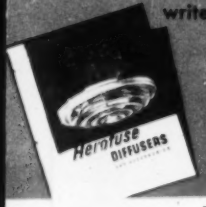
Aerofuse Diffusers are available in a wide range of types and sizes. For the details, size selection information, and complete engineering data . . . write for a copy of Catalog 102.



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NEW BRITAIN, CONNECTICUT

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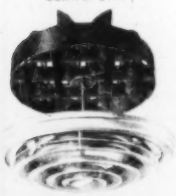
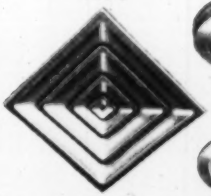
THE AEROFUSE LINE . . . . .

TYPE EAC with No. 4 Volume Control Unit



TYPE D



TYPE ES

TYPE E

TYPE S

TYPE R

TYPE H

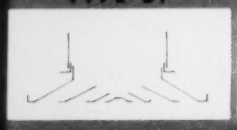
TYPE LF

New Aerofuse TYPE D

SQUARE DIFFUSER

360° AIR DISTRIBUTION or any required pattern at the vital point of air delivery

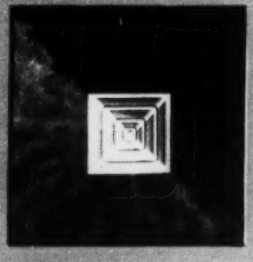
TYPE DF



TYPE DE

Styled to harmonize with modern architectural design . . . engineered for efficient performance . . . the new Type D Aerofuse is the answer to demands of both architect and engineer for a square diffuser that will deliver supply air in a 360° pattern. Assuring a complete flexibility to meet specific job requirements where circular distribution is not practical, baffles may be used to block off any portion of the diffuser and direct air stream in a variety of patterns, as illustrated below.

Two types are available . . . Type DF for flush mounting in standard acoustical tile ceilings . . . Type DE, for installation on plaster ceilings. Both types are listed in five sizes (12"x12", 16"x16", 20"x20", 24"x24", 30"x30") with neck diameters from 6" to 15".



For complete details on the Type D Aerofuse, size selection information and engineering data . . . send for Catalog 103.

TUTTLE & BAILEY inc

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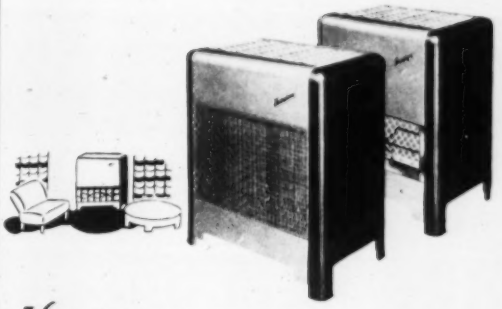
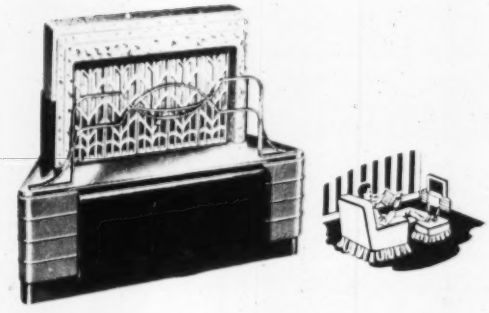
...GAS HEATING AT ITS BEST!

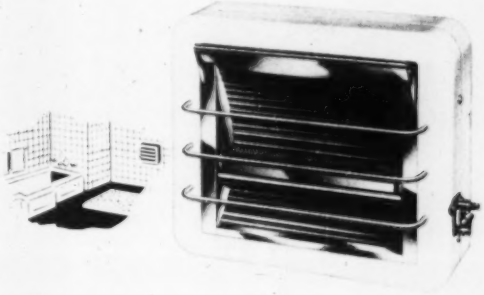
You can sell Humphrey Gas Heating equipment with confidence that you are giving your customers complete satisfaction in styling, heating performance, and economical operation.



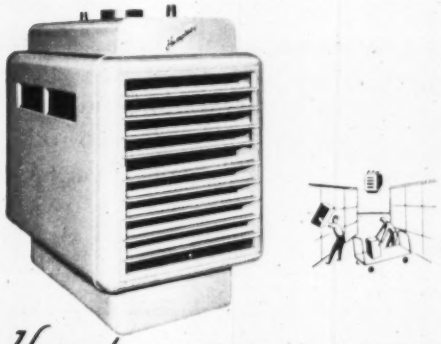
Humphrey **CIRCULATORS** Unsurpassed in ability to produce fast, clean heat . . . modern, beautiful styling . . . low cost operation. Two models . . . Open front Radiantfire Circulators and Closed front Royaline Circulators. Manual or automatic operation.



Humphrey **RADIANTFIRES** One of the most popular gas heaters ever made . . . abundant, satisfying heat with all the cheerfulness of an open fire. Available in vented and unvented models . . . manual or automatic operation.



Humphrey **WALL HEATERS** Ideal for bathroom, sunroom, den, playroom and many other places where economical auxiliary heat is needed. Designed for your choice of mounting — recessed in the wall or mounted on the wall. Easy to install.



Humphrey **AUTOMATIC GAS UNIT HEATERS** Completely "packaged" circulated heat for stores, shops, restaurants, garages, factories, etc. No boiler room equipment or fuel storage. Exclusive Humphrey construction assures maximum heat output at lowest fuel cost. A size for every need.

There is no substitute for experience. For more than fifty years we have been designing and building gas heating equipment *exclusively* . . . that is why there is no finer line of gas heating equipment made.

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THE EDITOR'S PAGES

THE PUBLISHER of a most informative booklet on planning for and conducting an engineering meeting sent us a review copy of it the other day, and we found it full of good, practical suggestions. One of them was that the publicity chairman for a meeting should always double-space his news releases to newspapers and magazines, and should leave ample margins. . . . Guess what? . . . . . The news release accompanying the booklet was a full page, single spaced, very small margins. But it's still a very useful booklet. . . . . The switchmen's strike against the Rock Island and some other railroads last month bothered us in at least two ways. For one, it meant we had to commute by thumbing, street-car or bus. For another, we had an item in our July issue about how commuters looked for seats on the Rock Island's air conditioned suburban coaches, and it read a little silly when there weren't any kinds of coaches running at all. The trains started again, though, about the time the July issue reached its readers, and we've found a seat in one of the air conditioned cars almost every trip since. . . . . The incident reminded us of a minor publishing problem during fuel oil rationing. It seemed that every time we'd decide to print the up-to-date fuel oil rationing order with all amendments, they'd put through 10 or 20 more amendments between press day and mailing date and we'd have to start all over again.

HERE'S CHECK LIST ON INSULATION

SOME BUILDING owners are losing money through heat losses from insulation faults which, if eliminated, can bring substantial returns on comparatively small investments. The Magnesia Insulation Manufacturers Association offers the following quiz to check on the efficiency of insulation methods and materials.

Each "yes" answer rates 10 points. "No" answers are zero. A score of 90-100 indicates a well insulated system, a score of 80-90 indicates only minor imporvements are required, 70-80 shows the need for some major insulation changes, and any score below 70 proves the need for a thorough survey, says the MIMA.

1) Are all major pieces of equipment and piping insulated?

2) Are flanges, fittings and valves insulated?

3) Are condensate or hot water return lines insulated?

4) Has damaged insulation been repaired or replaced?

5) If insulation has shrunk excessively, exposing bare pipe at insulation joints, has it been repaired or replaced?

6) If insulation has deteriorated so as to impair its insulating value, has it been replaced?

7) Are insulation thicknesses economical based on today's fuel costs, insulation costs, operating temperatures, hours of operation, conductivity of insulation and rate of deterioration of insulation?

8) Have special protective finishes been applied at points where mechanical abuse, excessive moisture or other hazard to insulation is likely?

9) Have repairs been made to torn, broken or otherwise damaged finishes?

10) Have loosened tie wires or bands been tightened and corroded tie wires or bands replaced?

AIR FLOW DIRECTION CHANGED FOR FRESHNESS

A UNIQUE feature of the ventilation in the lower part of the new Chamber of the House of Commons (London) is that air is introduced first from one side and then from the other, according to W. F. Moore, in an article in The Heating & Ventilating Engineer & Journal of Air Conditioning.

The change-over is automatic, and it is expected that the time-cycle will be of the order of three to 10 minutes between each reversal. It is believed that this will create sensations of freshness which a continuous air movement in one direction could not achieve.

Investigations with models showed that air entering from both sides simultaneously tended to produce very unstable conditions where the two streams impinged.

ATOMIC GOLF BALL CAN'T GET LOST

AN ATOMIC golf ball that can't get lost was demonstrated recently in Akron. Minute quantities of radioactive materials embedded under the cover of the ball make it possible for a caddy carrying a small Geiger counter to locate the ball even when hidden in dense woods or deep rough.

This answer to a duffer's prayer was developed at the B. F. Goodrich research center by Dr. William L. Davidson, director of physical research. He said the project is experimental and that no sale of radioactive golf balls is contemplated at the present time.

This news has nothing to do with heating, piping or air conditioning, of course, so perhaps we shouldn't bother to print it. However, after observing *some* of our readers playing in tournaments at various industry conventions this summer, we've decided that it will be of service to bring this information to light in these columns.

NEW OFFICE FOR WILLIAM GOODMAN

WILLIAM GOODMAN, widely-known consulting engineer, and member of HPAC's board of consulting and contributing editors, has announced the removal of his office to 53 W. Jackson Blvd., Chicago 4. Mr. Goodman has acted as consulting engineer for air conditioning, heating, refrigeration and other mechanical and electrical systems for many large projects, among them the 15 story Cook county internes' dormitory, the new air conditioning system for the Bismarck hotel, the new loop Spiegel store, all in Chicago, and the Three Sisters stores in Rochester, N. Y., and Denver. He has recently completed plans for the large Gordon department store, Gary, Ind., and for the famed Kungsholm puppet opera theater in Chicago.

Readers of HPAC will recall Mr. Goodman's basic research, and his many articles in the fields of air

conditioning, heating and refrigeration, which we have published. Mr. Goodman is also the author of two widely-used books: Air Conditioning Analysis, and the Trane Air Conditioning Manual.

Mr. Goodman's talents are diverse. He is unique in that he not only carries on an active engineering practice but also finds time to act for a few hours a week as a professor at Illinois Institute of Technology, teaching air conditioning and heating.

A.C. FOR HEALTH CAME FIRST

DR. JOHN GORRIE, of Apalachicola, Florida, was awarded a patent 100 years ago on the first American ice-making machine, thus marking the beginning of the ice industry in this country. A review of his work and that of other early inventors makes interesting reading in last month's issue of the magazine Ice and Refrigeration.

Of particular interest, it seems to us, is that Dr. Gorrie's invention was the result of his efforts to develop a method of cooling bedrooms of patients suffering from malaria and yellow fever. He had noticed, about 1833, that as air temperatures dropped, his patients' fevers lowered.

Thus, air conditioning is not an "offshoot" of the ice-making and refrigeration industries, but actually their forerunner.

22% OF FHA TITLE I LOANS FOR HEATING

ONE DOLLAR out of every six of loan insurance written by the Federal Housing Administration is for the repair, alteration and improvement of existing properties.

About 22 percent ($134.7 million) of the cash disbursed in 1949 by the 4000 financial institutions operating with Title I insurance was used for heating systems, 16 percent for additions and alterations to properties, 16 percent for exterior finish such as paint, 12 percent for insulation and the remainder for plumbing and other purposes. However, since only the primary purpose of a loan is reported to FHA, it is possible for a portion of a heating loan, for example, to be used to finance other repairs.

Almost 78 percent of the amount of these loans in 1949 improved single-family homes and 13 percent improved multi-family dwellings. The remaining 9 percent was quite evenly distributed among commercial and industrial structures, farm buildings and miscellaneous.

ROOM CONDITIONERS FOR NEW APARTMENT

EACH OF THE 254 apartments in the new eight-story Crestwood apartment building, Washington, D. C., will be equipped with room air conditioners which will provide both summer cooling and winter heating, according to J. D. Hoffman, manager of direct sales of General Electric's air conditioning department. A total of 448 units will be installed. The units will permit room occupants to select whatever comfort conditions they wish by merely flicking a switch. The cooling equipment, located in the basement, will consist of a 350 ton compressor with water chiller.

Berla and Able are the architects, Charles B. Broome the contractor and General Engineering Associates the consulting engineers.

WHITE BUS TOPS FOR COOLER RIDES

THE HOUSTON Transit Co. has started painting the tops of its 600-bus fleet white, according to the New Jersey Zinc Co., because extensive tests have indicated that a slow-chalking white enamel containing zinc oxide actually lowered average temperatures inside a bus 6 to 8 deg more than when other kinds of paint were used on the roof. Some of the "white toppers" have been in use for two years.

IS THE WORLD GETTING WARMER?

WITHIN THE next few generations, air conditioning and summer clothing may be in great demand in Greenland, Iceland, Alaska and all points north. At least that's the opinion of some of the world's climatologists, who said in an article in the Saturday Evening Post, entitled Is the World Getting Warmer? that it is.

The article, which appeared in the July 1 issue of the magazine, explained that the vast ice pack that is Antarctica is thawing out, glaciers are melting and formerly ice-bound land is emerging. According to the article, this warming up process will continue for some time to come.

We haven't been trying to scoop the SEP recently, but Dr. Clarence A. Mills, in his article on Temperature Dominates Mankind, in the May HPAC, said that we are now in one of the long cycles of climatic change that "alter the course of nations and of world trends."

THE ENGINEER AS A MANAGER

THE ENGINEER as a Manager is a new four page folder available from V. W. Palen, Bureau of Public Information, New York University College of Engineering, New York 53, for 10¢.

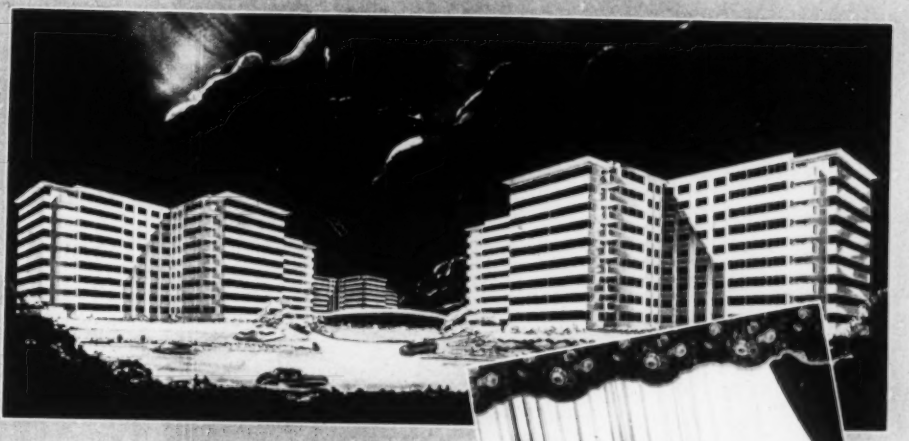
The text was prepared by Dr. J. M. Juran, chairman of the department of administrative engineering, and covers the relationship of management to engineering, a case history of an engineer who became a manager, does study of engineering qualify one to become a manager, what must an engineer do to become a manager, should the definition of engineering be opened up to include management, and training engineers in management.

It is pointed out that the distinguishing feature of engineering is the use of "the forces of nature" for the benefit of man, while the distinguishing feature of management is the use of "the forces in people," also for the benefit of man.

CONSULTING ENGINEERS EXPLAIN CONDITIONING

AN ATTRACTIVELY printed four page "letter" prepared by Syska & Hennessy, Inc., consulting engineers, New York City, and distributed to building owners and managers, explains such air conditioning terms as tons of refrigeration, zoning, refrigeration cycle, direct expansion, reheat, preheat, dehumidification, etc.

Air conditioning is a subject that has been kept prominently before all building owners and managers, says the letter, by the competition and plans for many fully air conditioned office buildings, the New York City water conservation regulations which affect existing installations, and the torrid summer last year. Much of the publicity given air conditioning has, however, tended to confuse the average layman's understanding of it.



—at Park View

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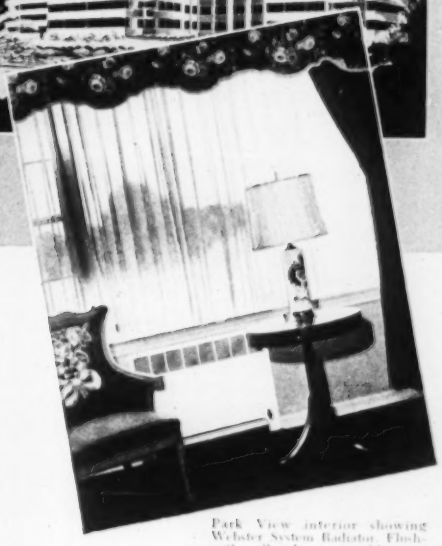
The $10 million Park View development in Collingswood, N. J., is the largest post-war apartment in the Philadelphia area. The arresting design with an almost unbroken expanse of window space has won professional acclaim. Television, radio and newspaper promotions have brought thousands to the model apartment.

The owners of Park View put comfort first. They provided a "Controlled-by-the-Weather" Webster Moderator System of Steam Heating. With fully recessed Webster System Radiation . . . Convector Radiators with built-in radiator trap and valve. Each radiator has a convenient, accessible, easy to operate handle providing complete shut-off at tenants' convenience.

With the Webster Moderator System, heat is delivered continuously — plenty of heat in really cold weather, mild heat for mild days. The supply of steam is varied automatically with changes in the weather. There's a Webster Radiator Valve for 100% heat shut-off from each radiator — no dampers are needed.

Park View is owned by Sylvester A. and Sylvester J. Lowery. The Builders are S. J. Lowery and E. J. Frankel. The architects were J. Raymond Knopf and Samuel J. Oshiver (associate). Engineers included Robert E. McLoughlin, Salvatore S. Guzzardi, and Robertson & Johnson. The heating contractor was Benjamin Lessner Co., Inc.



Park View interior showing Webster System Radiator. Flush-with-wall, takes no useable room space. Metal front provides easy access if necessary. Convenient, quick shut-off handle.

Park View was financed through County Trust Co., Tarrytown, N. Y., with the Seaman's Bank for Savings of New York as permanent mortgagee. It is insured by FHA.

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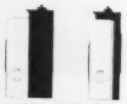

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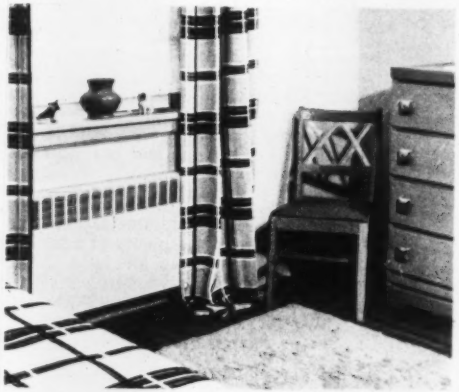

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DO YOU HAVE something you'd like to say about any of the articles published this month? An additional comment, or perhaps a question on some point? Or do you want to express your views on some other matter of interest to heating, piping and air conditioning engineers or contractors? We follow here the custom at engineering society meetings of providing an opportunity for discussion following presentation of a paper. You are invited to participate. Just address your remarks to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

DISAGREES REGARDING LIFTS IN RETURNS

THE FIRST HALF of Sam Lewis' article in the June HPAC concerns state license laws for professional engineers, and also "charity engineering" as dished out by salesmen to architects.

I agree completely with Mr. Lewis on the futility of license laws. They eventually turn out to be merely another method of taxation. We have enough taxes now. Nearly 40 cents out of every dollar we spend for every article we buy from a loaf of bread to a new automobile goes for taxes in the process of production from the raw materials to the finished article delivered to the customer.

As to charity engineering, it never turns out to be serious competition for established engineers. The other salesmen generally take care of it, by breaking the flat specification of the salesman who spends his time making "for free" layouts for architects. The architect may then have a sour job and the salesman who made the layout a headache over the lost time that he might have put into selling his equipment on other jobs.

As to the second half of Mr. Lewis' article, on lifts in vacuum return mains, I do not agree with his comments. Theoretically, lifts in return piping may be satisfactory in a vacuum return system. Actually, they are likely to be a source of much trouble. I have cured quite a number of sick heating installations by taking out the lifts in returns.

Taking the lifts out of return mains was my prescription for a large high school some 20 years ago and for another high school some five years back. Both of these sick systems made excellent recoveries.

I have a case of this variety at the present time. The custodian of an old California school with a vacuum return heating system reported trouble. In December and January (sunny California had prolonged 26 to 30 deg weather) it required $2\frac{1}{2}$ to 3 hr to get all the radiators hot. While this was going on, the custodian had to feed a lot of water to the boiler to replace the water tied up in the returns that the vacuum pump did not pull back during those peak load hours from 5 to 9 a.m. Of course, the water came back when the building was finally warmed up and then it had to be drained to the sump. This makes a sad way to operate a heating system boiler.

A suggestion was made to the board of education's maintenance engineer that he would probably find 2 ft lifts at the steam main terminals under the end classrooms (which did not heat properly in 3 hr of boiler operation). This was confirmed by his journey under the building on all fours. These lifts will be removed by lowering the return mains all the way back to the boiler room. The prescription is 1 in. drop across the drip trap from steam main end to return line start. Condensation will then flow through the drip trap into the return line by gravity. The vacuum pump can then get proper circulation by getting out the locked up air and allowing free circulation of steam.

When you depend on pressure difference between the two sides of a drip trap, you require a solid and continuous column of water to get effective uphill pumping. If the trap is sensitive to steam it is opening and closing quite frequently. It also has to pass air along with condensate. This makes the required solid column of water in a lift difficult to attain. If you have vertical lifts of 2 ft or more at the far ends of steam mains to get the condensate from the drip trap up into the return main you certainly need a solid column of water in the vertical pipe to get results. This is attested to by the small size vertical pipe in well designed lift fittings. Such lift fittings are intended to lift the water up in slugs, but if the vacuum is weak and the air is plentiful the lifts get in trouble.

Unless the quantity of water is sufficiently great to fill the main or mains completely full, a vacuum cannot make it flow any faster. The real value of the vacuum pump in steam heating systems is to get the air out of and the steam into all the steam piping and heating units whether they are radiators, convectors, or other heating apparatus. A vacuum pump has two rotors or one rotor and an air ejector and its work is divided into two parts. The vacuum rotor or the ejector gets the air out of the system and the other rotor pumps the water into the boiler. It is expecting too much, in my opinion, of a vacuum at the far ends of return piping to do vertical lifting of water on an interrupted operating basis.

When a heating system is brand new, the radiator valves do not leak air, the traps all close tight against steam and the vacuum pump performs effectively, properly designed lift fittings may then function as intended. But why resort to lifts for the long pull of the expected life of a heating system if you can design a system without them?

If you have to get condensate back uphill due to site conditions, put a vacuum pump at the lowest point of the building and pump the water back to a receiver in the boiler room through a separate return line. As to making a direct

lift at the vacuum pump suction inlet, why reduce the time available in pulling air out of the system by cutting off the free flow of air by intermittent slugs of water traversing the vertical pipe of the lift fittings. It is better to insist on complete gravity drainage of all condensate into the vacuum pump-receiver inlet connection.—O. W. Ott, consulting mechanical engineer.

INDUCED VACUUM SOURCE OF HEATING TROUBLE

In the April HPAC, it was pointed out in Sam Lewis' Page that induced vacuum is often a source of trouble in low pressure steam heating systems. Mr. Lewis then discussed a recent and costly freeze-up in the tempering convectors of a large indirect heating system.

The installation in question was not up to standard in two instances, in my opinion. The first of these was the fact that the return main connection to the discharge of the trap on the convector was at a point higher than the convector itself. The other is that instead of using a combination float and thermostatic trap, a separate float trap and thermostatic trap was used.

The fact that the return main was higher than the convector would allow water to lie in the convector at all times. Float traps are not recommended for such installations due to the fact that there is the possibility of airbinding in the body of the float trap which would prevent water entering the trap. For such installations, only the combination float and thermostatic trap should be used.

The installation of an equalizer between the convector and the return main would certainly not have drained this convector even though the check valve in the equalizer did operate to equalize the pressure in the convector with that existing in the return main. There being no pressure differential between the interior of the convector and the return main at that time, there would be no force to cause the water to move into the return main from the convector. If the discharge of condensate from the convector was by gravity through the trap and into the return main also by gravity, the equalizer would then tend to cause the condensate to flow from the convector into the return piping.—J. W. Jungels, C. A. Dunham Co.

Reply by author—Mr. Jungels criticizes, as I did, the fact that the condensate return main was not at the bottom of things. He also suggests that the frozen coils should have been drained by a combination float and thermostatic trap rather than by a separate float trap and separate thermostatic air trap.

I stated in my article that if a sufficient difference should be maintained, with the higher pressure inside the coil and the lower pressure in the return main, the condensate would be forced up into the objectionably high return main. This difference could be due to steam pressure above atmospheric, or due to return main pressure subatmospheric, following the efforts of the vacuum pump.

If the check valve that I suggested does open to equalize the pressure, in the return main, there will of course be no pressure differential to lift the water up into the return main. The vacuum pump, however works to build up a subatmospheric pressure, and steam at above atmospheric eventually enters the coil and as a result the suggested check valve closes, and the condensate must be forced down out of the coil and up into the return pipe.—Samuel R. Lewis, consulting mechanical engineer, and member of HPAC's board of consulting and contributing editors.

Mr. Jungels comments further—Mr. Lewis does not mention the cause of the freeze-up of the convector; namely, closing off the steam supply which allowed the vacuum to be induced in the convector.

Had a sufficient pressure differential been maintained between the convector and the return main, as mentioned by Mr. Lewis, there would have been no need for a check valve. As mentioned in my comment, if the induced vacuum caused water to be held in the convector, the addition of the check valve would not have cleared the convector water due to the difference in elevation between the trap and the return main.

If the discharge of condensate from the convector to the return main was by gravity flow, the check valve, by equalizing pressures in the convector and return piping, would have been of value but under the installation conditions stated in this problem, it is of no value—J. W. Jungels.

SHOOTING TROUBLE IN REFRIGERATION SYSTEM

I have read with interest the article by George Holman in the April HPAC on shooting trouble in a refrigeration system. It recalls some of the experiences that I have had in troubleshooting. It is not uncommon to find a system loaded with air because many mechanics don't know how to properly remove the air after the piping has been opened for repairs.

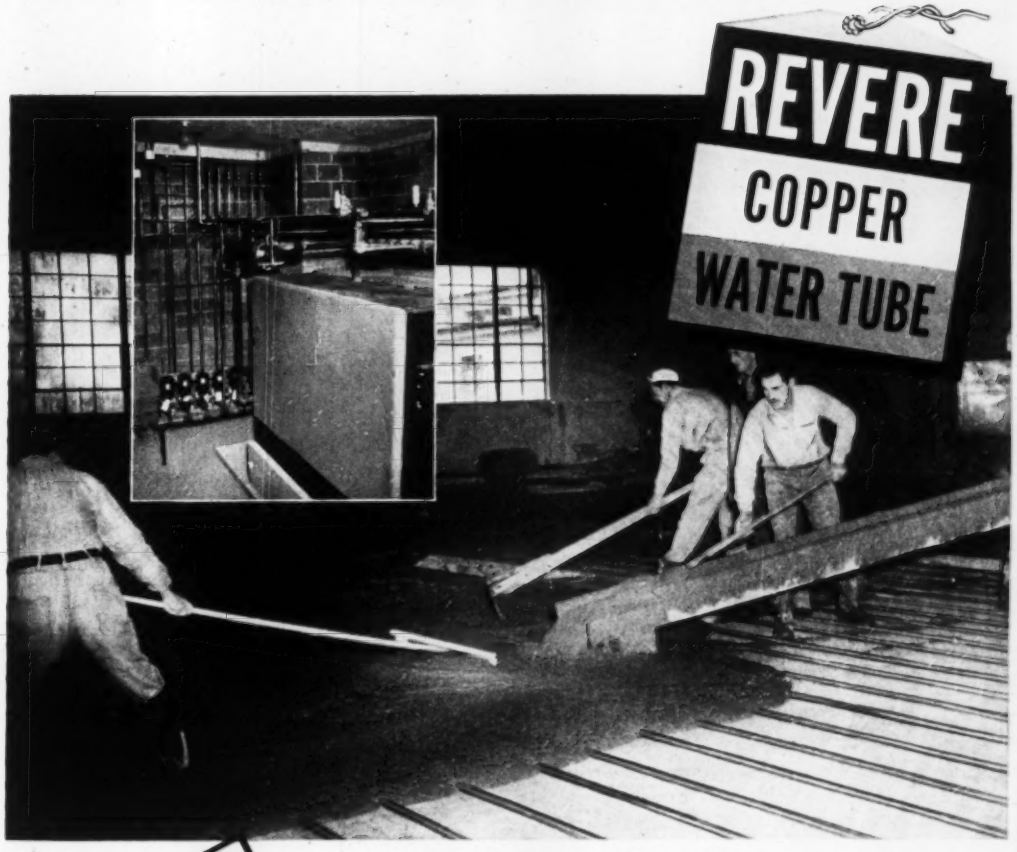
Most refrigerating plants are now equipped with purgers operated either automatically or manually. When a plant is not so equipped and when the system has a large quantity of air and non-condensable gases, the most effective method of purging is as follows:

Shut down the compressor; shut the main liquid supply valve, usually called the "king" valve, at the receiver; close the compressor discharge valve; remove the pipe plug below this valve and connect a hose to this connection so that the air can be discharged outdoors; after the pressure in the low or evaporator side has been reduced to atmospheric pressure, start up the compressor and pump out all of the air from the low side.

When purging in this manner, do not depend upon the gage as proof that all the air has been removed. A more positive sign is to hold the palm of your hand against the purge connection and when no pressure is felt against the palm the system is then reasonably free of air.—Herman Vetter, consulting engineer.

"QUOTE"

"The purity of the air we breathe is no less important than that of the food and water we consume, but the problem of its control is considerably more difficult. . . . The causes of air contamination are therefore of primary concern to every citizen."—Henry T. Heald, president of Illinois Institute of Technology, in a paper on Cleaner Air for a Big City.



Concrete is being poured over 1" Type L Revere Copper Water Tube in this radiant panel heating installation at Driscoll Chevrolet Agency, Spring Valley, New York. Boiler and zone circulators are shown in inset.

Architect: Joseph M. Pilati, Pearl River; General Contractor: Harvey B. Keesler, Spring Valley; Heating and Plumbing Contractor: Irving Keesler, Spring Valley; Consulting Engineer: Roger M. Wells, Bayside, Long Island.

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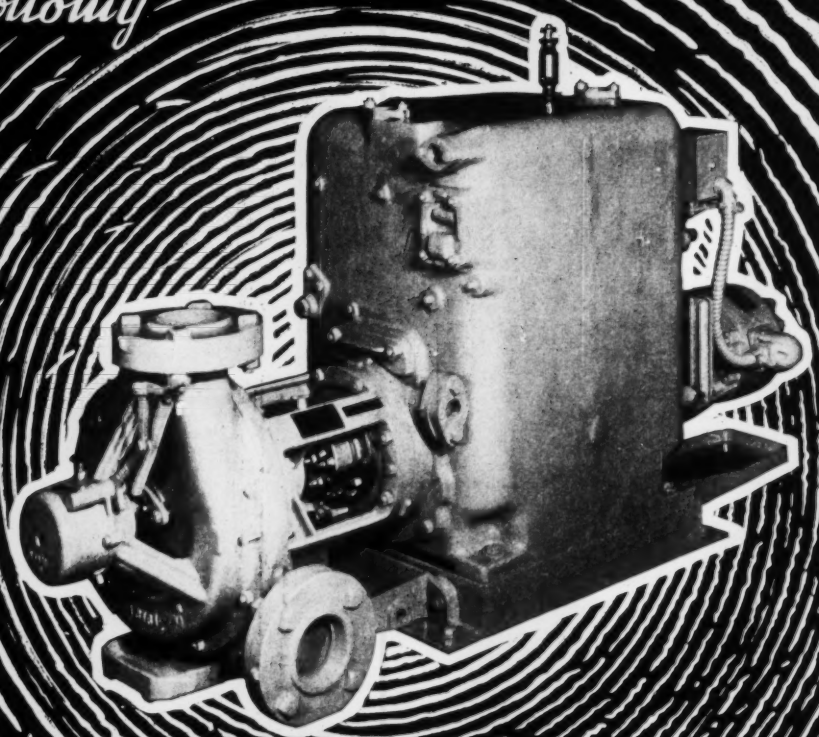

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Modernization With Piping Ups Production Efficiency

PIPING is industry's greatest transportation system, and here's another specific example—the extensive installation at the Tousey Varnish Co. Modernization of the plant production facilities with new piping, pumps and tanks has resulted in some 17 advantages, which are listed herein and which range all the way from eliminating hazards to decreasing the costs of raw materials. Plants in many types of industries offer similar opportunities for improving production and reducing hazards through installation of the right piping facilities

TWO MEN WOULD have to work fast to truck a 50 gal drum of alkyd resin or solvent across a 150 ft yard, into a building, up to the second floor, and empty it into a storage tank—all in four minutes! Even with several times this many men working, it would still be a tiring operation all day long.

Yet this was the work being done by crews of men at the Tousey Varnish Co., Chicago—200 drums of raw materials coming into the plant each day, and 200 drums of finished products leaving. Today, even more materials are being shipped in and out, yet the work is handled by only two men—pump engineers.

To solve many problems, an extensive piping system, consisting of 10,000 linear ft of pipe complete with storage tanks and pumps, was installed in the Tousey varnish plant. This was part of a modernization program that has been in effect ever since Chester A. Tousey built his first modest varnish factory some 65 years ago.

The problems confronted before modernization were:

1) Increasing sales necessitated greater production.

2) Prices of raw materials were increasing.

3) Competition was becoming keener.

4) Labor costs were rising.

5) Work output per man was at a low level.

Increasing production meant a larger amount of materials to be handled, and already storage space was crowded. The aisles were jammed with men trucking drums of ingredients and products.

It would have been possible to build additions to the plant, but the estimated cost was high. And this would not solve the manpower problem, rising costs of raw materials, or the problem of keener competition.

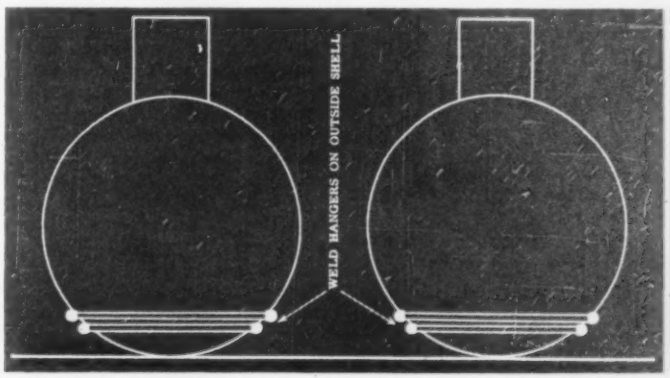
On the other hand, a piping system would take care of all these difficulties. Materials could be pumped around the plant faster than they could be trucked in drums, thus increasing production. Pumps would make it possible to use large underground storage tanks, whereby more materials could be purchased at a time to take advantage of large quantity prices in tank car lots in place of drums. It would take less manpower to do the work. These savings in material and labor costs would keep prices down to meet competition. Therefore, a piping installation with tanks and pumps was the logical answer.

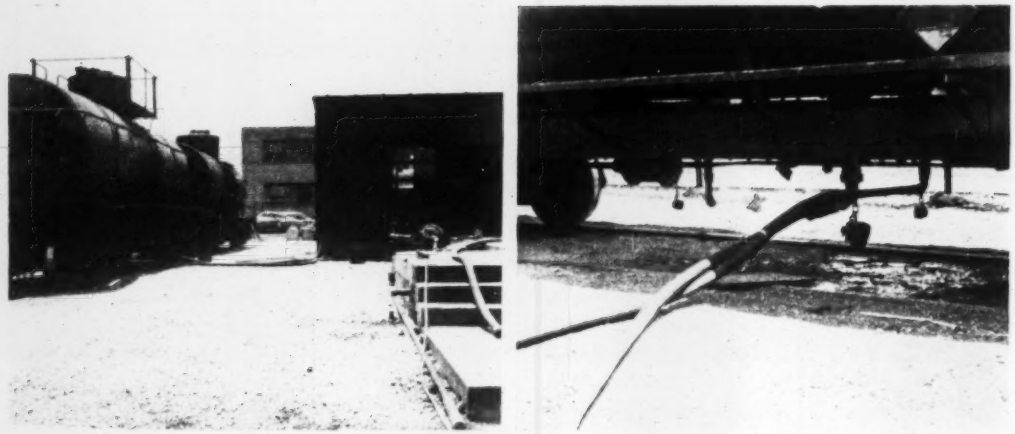
Advantages Resulting from Piping System

The new piping system has brought the following advantages:

1) Eliminates drums containing raw materials.

Steam coils were installed around the outsides of the underground storage tanks, to guard against contamination in case of coil leakage





***Left*—There are two pump houses, about 75 ft apart and along the railroad siding. Flexible hoses convey steam to the tank cars, or liquid to or from the pumps. *Right*—Steam condensate from the coils in the tank cars is trapped and dripped to the ground. If the condensate were returned, it might carry oil or other material back to the boiler in event of coil leakage**

2) Permits manpower to do more essential work than truck drums.

3) Reduces need for elevator or conveyor service.

4) Keeps plant cleaner by eliminating spillage in transit.

5) Reduces employee accidents by eliminating much of the heavy work.

6) Eliminates hazard of piled up drums.

7) Eliminates necessity of warming contents of drums stored outside in winter.

8) Eliminates work of freeing drums frozen into ice and snow.

9) Eliminates trucking of drums outside in inclement weather, thereby reducing colds and sickness among employees.

10) Eliminates continual opening and closing of outside doors in cold weather, reducing heat loss and cold drafts.

11) Gives more work area by eliminating drum storage.

12) Leaves aisles free by eliminating drum truckage.

13) Minimizes likelihood of wrong mixtures by limiting responsibility to the pump engineers.

14) Lessens fire hazard by keeping inflammables underground except during use.

15) Lessens fire hazard by minimizing exposure of inflammables to the atmosphere.

16) Accelerates transportation of raw materials and finished products.

17) Decreases cost of raw materials by permitting purchase in tank car lots.

Dougherty Brothers, piping contractors, installed the pumps, tanks and piping system. Two major considerations were involved in the design of the piping system, the flexibility of operation and the speed of handling. These two factors determined the piping arrangement, valve locations, pipe sizes, type of pumps, sizes of pumps, locations of the pumps, types of pump motors and the sizes of the motors.

Eighteen Underground Storage Tanks

The plant officials could foresee ever-increasing needs for great flexibility, so two pump houses were built. These are about 75 ft apart along the railroad siding at the eastern edge of the property, approximately 150 ft from the factory buildings. There are nine storage tanks buried underground adjacent to the north pump house, and nine adjacent to the south pump house. Since each tank has a capacity of 10,000 gal, total storage is 180,000 gal.

It was at this stage of planning that the first major problem was encountered. Some of the liquids are so viscous that they need to be heated before they will flow. This meant that the underground tanks and pipe lines had to be supplied with steam coils.

The contractors installed two steam coils around the outside of each tank. The tanks were set level on concrete bases in the excavations and dry sand was filled around them to act as heat insulation. Pipe fittings which permit movement of the tanks during settlement or expansion were fastened to the tanks, and a concrete slab was poured over the top of the tanks.

Keeping Viscous Materials Warm

Steam lines are run in the same tunnels as the piping from the pumps and tanks. These keep viscous materials warm in transit. Tunnel temperatures range from 85 F to 95 F depending on outside temperatures. The underground tanks are heated to 135 F for pumping.

Steam is supplied by two 25 hp vertical boilers, usually operated at 10 lb pressure. One is used as a booster during cold weather, or can be zoned to take care of one tank bed. At other times, it is used as a standby.

Before tank cars of viscous liquids can be unloaded, they must be heated for three or four hours, depending on the outside temperature. There are steam coils inside the tank cars, so provision was made for running flexible hoses from each pump house. One hose carries steam to the tank car, and another carries liquid to or from the pump.

Steam condensate from the coils in the tank cars is trapped and dripped onto the ground alongside the cars. If the condensate were returned, it might carry oil or other material back to the boiler in case the steam coil in the tank car leaked or broke. It was for this same reason that the steam coils were installed around the outsides of the underground tanks.

Piping Headers for Operating Flexibility

Maximum flexibility of operation was desired, so pipes from each of the 18 underground tanks and nine storage tanks in the plant were brought into a header in each of the two pump houses. Runouts to the tank cars, and pipe connections between the pumps also connect into the headers. This piping arrangement permits all the valves to be conveniently located along the pump house wall below the header.

There are always two pump engineers on duty together. This makes it possible to double check the valves and pumping operations. If there were a wrong mixture of liquids, it is possible they would jell. In an underground tank, this would be serious.

Before any tank car is unloaded, samples of its contents are tested in the Tousey laboratory. If the material passes inspection, it is stored in one of the underground tanks. Liquids from these underground tanks are pumped into temporary storage tanks on the second floor of the plant. There are nine of these temporary storage tanks, each holding 500 gal.

When one of these tanks needs filling, plant men phone the pump engineers. There are telephones near the plant storage tanks and in the pump houses. The pump engineers are told which liquid to pump, into which tank it goes, and how much. With telephones right at the strategic points of all pumping operations, instantaneous control is possible at all times.

The pump engineers are warned when the tank is about full, and then told exactly when to stop pumping. There is little chance for error with this procedure, combined with the fact that there are two pump engineers operating and checking each other. Proof of this is the fact that while 10,000 or more gal per day is used from underground tanks, there hasn't been a mistake yet.

The liquids in the temporary storage tanks on the second floor of the plant are run into the seventeen 500 gal synthetic enamel mixing tanks on the first floor. The solvents flow down by gravity, and the alkyd resins are pumped.

A pump engineer, stationed in the plant, handles this operation. He meters liquids into the mixing tanks, ground paste is weighed in, and solvents, driers, and other liquids are added according to formula.

The product is shaded to standards set by Tousey. Then samples are sent to the laboratory for test.

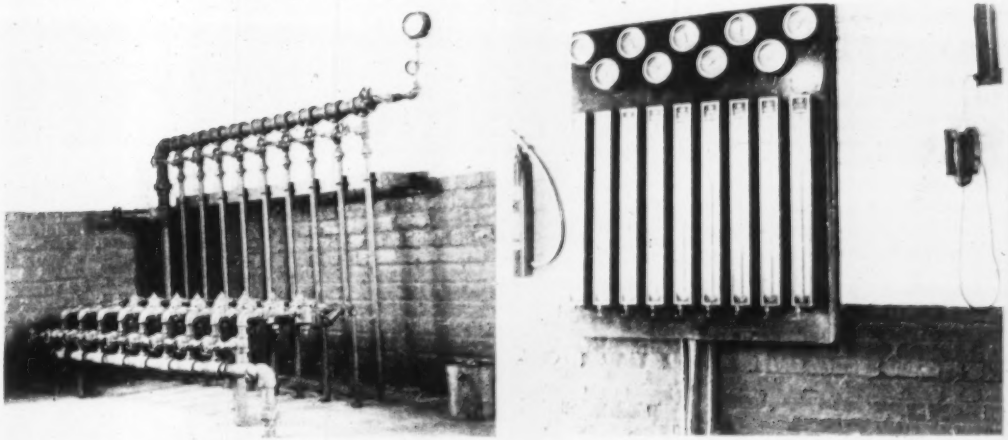
At the end of each stage of manufacture, the contents of the storage tanks on the second floor are pumped back into the underground tanks as a fire precaution.

The piping arrangement makes the following operations possible. Tank cars can be unloaded simultaneously at each pump house. The contents of one tank car can be pumped into a tank car at the other pump house. The contents of one tank car can be emptied into either an underground storage tank or a tank in the plant while the contents of any other tank are being pumped into another tank car. It is possible to pump from any tank into any tank and back again.

On a wall in each pump house is mounted a board of nine liquid level gages—one for each of the adjacent underground tanks. Also on the board are indicating thermometers that give the temperature of the liquid in each of the underground tanks.

According to C. E. Walde, superintendent of the Tousey Varnish Co., the new piping system "is working out very well for us. The underground tanks don't interfere with motor transport deliveries to the various buildings, they leave the yard free for use, and the combustibles are safely stored underground."

***Left*—Piping from the various underground and plant storage tanks is brought into headers in the pump houses for flexibility of operation. *Right*—Nine liquid level gages—one for each of the adjacent underground storage tanks—are mounted in each of the two pump houses**



Liability for Negligence in Engineering and Construction

JOHN S. MASON, general counsel for the Dravo Corp., makes some observations here on liability for negligence in construction and engineering work. Common sense and judgment are the basic rules of conduct on which the whole law of negligence is built, he points out. His remarks and examples should be helpful in avoiding legal pitfalls to those engaged in construction

THE LAW is nothing but common sense and good grammar. The latter involves principles of good and complete language, written or spoken. Oral arrangements should be definite and complete. The writer must say exactly what he means—no more and no less—in legislation, deeds, mortgages, leases, wills, trusts, insurance policies, contracts, specifications, proposals, purchase orders and everything else. The fine print is an essential part of modern business transactions.

I should like to emphasize here common sense—the common sense aspects of negligence. The definition of negligence is doubtful. It means the opposite or lack of due diligence or care. The lawyer regards it as a violation of a duty to use care. Generally, it means fault. As applied to construction and engineering activities, it might mean faulty or improper design; selection of inadequate materials; poor or insufficient inspection or testing; faulty planning of the sequence of work and operations; or shoddy construction itself. As a practical matter, it can mean almost anything.

Negligence and care include acts of omission as well as commission and run through all the activities of life. Let us single out a few typical situations and make some observations.

The law deals with relationships and the duties and responsibilities which follow those relationships. The thief who breaks into a grocery store and falls into an open trap door has no claim against the proprietor; it is a different picture if a customer has a similar fall.

Trespassers on Construction Jobs

We have the problem of trespassers on construction jobs. Our only obligation to adult trespassers is to refrain from intentionally causing them injury. In other words, they take the premises as they find them. It is not so with trespassing young children. Everyone knows that children are attracted to construction sites, abandoned structures and idle machinery. If children are in the locality, the law takes the position that the owner or contractor knows or should know they will come there to play and it can be reasonably expected they may be injured. In such case, the law imposes an affirmative obligation to take all reasonable precautions to prevent access or otherwise eliminate the hazard.

A minimum of duty and a minimum of care is required toward the adult trespasser. A maximum is due the business visitor on the premises, or the general public off the premises. In between are persons who have no business thereon but who, for example, have been taking a short cut across the property and have been doing so for some time with the acquiescence of the owner. Such persons probably started out as trespassers but through time and acquiescence have graduated into one of those in-between classes of licensees and to them there is owing some in-between degree of care. For negligence is a question of care or neglect under all the circumstances and background of the particular occurrence.

The law is nothing but common sense and good grammar, the latter involving principles of good and complete language

Especially Hazardous Situations

In especially hazardous situations, such as those involving use of explosives or installations of an experimental nature inherently dangerous, the law passes from liability based on negligence to absolute liability; in other words, liability for injury or loss regardless of the maximum of care used and the absence of any fault. In this connection, bear in mind that the law's point of view is hindsight. The accident often speaks for itself—less powder should have been used in the charge, or the tank that exploded should have had heavier plate.

Negligence usually results only in civil liability for damages, but if the conduct is particularly reckless or equivalent to willful disregard of all consequences, there will be criminal liability. Construction superintendents have been charged with manslaughter.

Liability attaches to all negligent action. I have noticed particularly among engineers a belief that an engineer is not liable for loss resulting from his negligent design of

a structure and its consequent failure—or any other fault resulting in injury. This is completely erroneous. The doctor who performs an operation, the lawyer who searches a title and the engineer who designs a bridge are all liable for losses resulting from mistakes they should not have made. Everyone is liable for injuries naturally resulting from his actions—or inactions, when there is a duty to act. If the individual is working for another, the employer is also liable. When an employee truck driver is involved in an accident as a result of his negligence the employer truck owner is liable to the persons injured—but so is the driver.

I often hear it remarked that the risk involved in the sale and installation of a $1000 job is not important, on the theory that the maximum liability is the purchase or contract price. This is without foundation. A catastrophe may result from the furnishing of a small defective part just the same as from the engineering and construction of a complete power plant, and there is liability for the consequent injuries. The price received is not relevant. If we volunteer to do work for nothing, and do it negligently, we are liable. The law says that if you do it, you must do it right.

What Is Extent of Liability?

Assuming negligence, what is the extent of the liability? The answer is: All the loss or injury which can be reasonably anticipated to follow. If waste fuel oil is discharged into a river in an industrial area and it is reasonably foreseeable it might become ignited, it is no answer that you did not think you would set the river on fire and destroy docks and piers several hundred feet down the river. Similarly, the barge which is not properly tied up, gets loose, drifts and collides with other craft or moorings below. This could readily have been foreseen. The lawyers call it proximate causation—liability attaches to all the proximate consequences of the negligent action or inaction. Sometimes this may be a chain reaction set off by the negligent act but all the subsequent events normally can be expected to follow from the action and so the law attaches liability.

I have not as yet mentioned contributory negligence. Contributory negligence bars recovery, the theory of the law being that if both parties together negligently caused the loss, neither may recover from the other regardless of the respective degrees of fault. An exception is the marine rule of dividing damages. If two automobiles collide, each suffering the same amount of damage, and one was 10 percent responsible and the other 90 percent, or both were equally at fault but one incurred 10 percent and the other 90 percent of the damage, neither may recover from the other. If, however, the automobiles were towboats, the total damages in both cases would be borne on the basis of the relative negligence of each.

Generally, one cannot contract himself out of liability for his future negligence. At one time or another, we have all signed releases prior to entrance into factories. The releases purport to waive and release all claims for injuries which may be sustained while on the premises. These releases are of limited effect legally if the injuries are the result of negligence. Ordinarily, the policy of the law is that no one is to be permitted to be negligent, even with the permission in advance of the injured person.

How Negligence Is Determined

How is negligence determined? If the parties cannot agree, the law settles the questions, usually through a jury. Negligence is ordinarily a question of fact under all the evidence. The evidence consists of testimony of witnesses, interested and disinterested, eyewitnesses and expert, accurate and inaccurate, good and bad. Much too often, the lawyers and witnesses become involved in technicalities, details and fine points. The jury gets only an overall impression from the passing parade of witnesses. Lawyers will tell you that you lose cases you should win—and win cases you should lose.

I said negligence is ordinarily a question of fact and therefore determined by the jury. There are exceptions. The courts have determined certain acts are negligent regardless of the circumstances. For example, in Pennsylvania there is the "stop, look and listen rule" at railroad grade crossings and the failure to come to a complete stop is fatal to any recovery regardless of the care the motorist otherwise used and regardless of the negligence of the railroad.

A jury trial is not essential, but under our legal system those injured—the plaintiffs—are entitled to a jury trial if they so desire. The defendants in most negligence trials are municipalities, public utilities, industrial corporations or defendants represented by insurance companies. Most plaintiffs in negligence cases believe juries award more damages than judges. I am becoming more and more uncertain this is true.

A word about the jury system. I am not sure there is any better substitute. Several years ago there was a long and celebrated jury trial involving the issue as to whether a certain work of art was an original or a copy. I heard extended criticism among artists of this method of settlement of the dispute, but the fact was that the experts could not agree and were divided. The law let a jury determine after the experts had an opportunity to testify.

I said at the outset the legal principles governing negligence are rules of common sense. I have mentioned a few examples—from a field which is as broad as living itself. Common sense and judgment are the basic rules of conduct on which the whole law of negligence is built.

STANDARDS ASSOCIATION HONORS COUNCIL

THE AMERICAN Standards Association has announced awards to members of its standards council who have served more than a year, with honorary certificates given in recognition of their work in the development of industrial standards.

Among those in the field of heating, refrigeration, and air conditioning who were honored are Stewart E. Lauer, president, York Corp., representing the Air Conditioning and Refrigerating Machinery Association; Major Rowland Tompkins, president, Rowland Tompkins & Son, Inc., representing the Heating, Piping and Air Conditioning Contractors National Association; W. P. Kliment, Crane Co., representing the Manufacturers Standardization Society of the Valve and Fittings Industry; and L. W. Kattelle, Walworth Co., representing the American Society of Mechanical Engineers.

CENTRIFUGAL FANS

WILLIAM HUEBNER, engineer, Anemostat Corp. of America, presents

very briefly fundamental facts about a widely used item of equipment in air conditioning, ventilating and heating work—the centrifugal fan. Knowledge of fan facts is essential to proper selection and application

A CENTRIFUGAL fan consists of a bladed wheel rotating in a casing. The air enters axially near the impeller shaft, flows radially outward through the passages formed by the blades of the fan wheel and is then discharged in a tangential direction into the casing.

A fan is a low pressure, large quantity air pump. There are two independent sources of pressure generated by the fan wheel: the pressure due to the centrifugal force of the rotating mass of air; and the kinetic energy of the air due to its velocity upon leaving the periphery of the fan wheel.

Using the symbols of Fig. 1, we can express this by the following equations:

$$H_s = \frac{p_2}{\gamma} = \phi_1 \frac{u^2}{2g}$$

$$H_d = \phi_2 \frac{u^2}{2g} \quad \text{(assuming } c_u = u\text{)}$$

$$H = H_s + H_d = \phi \frac{u^2}{g}$$

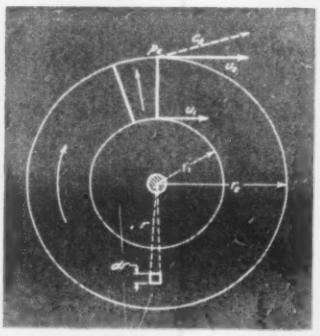
where H_s is static head; H_d is dynamic head; H is total head; c is absolute velocity of air at tip of blade; u is peripheral velocity of air at tip of blade; p is static pressure at tip of blade; γ is specific weight of air; g is acceleration due to gravity; ϕ_1, ϕ_2, ϕ are factors depending upon losses in the fan.

The equations show that a centrifugal fan with ideal performance and no losses develops a total head equally divided between static and velocity energy. In reality, all fans have friction losses, shock losses and leakage. These losses vary widely with the design and it is practically impossible to evaluate them separately. The amount of total pressure developed by a fan as influenced by the blade curvature (a most important item), the number of blades, their radial depth and the various other design elements therefore cannot be determined from theoretical considerations alone but has to be checked by experiment.

Three General Types of Centrifugals

Centrifugal fans are of three general types: forward curved multiblade fans; straight radial blade fans (the "original" centrifugal fan); and backward curved multiblade fans. A forward curved blade fan is slower and a backward curved fan is faster than a radial blade fan producing the same volume and pressure. Therefore, the three types can be characterized as slow speed, moderate speed and high speed types, although the actual speeds of each of them overlap.

Fig. 1—Symbols used in development of fan equations



Straight radial blade fans have played an important role for many years in the form of the "steel wheel" or "paddle wheel" fan with six to 12 blades, but today most designs of centrifugal fans are of the multiblade type. Forward curved multiblade fans are known by various names, such as "forward curve," "multivane," "multiblade," "squirrel cage," "sirocco" and also are called "volume fans" because they occupy a minimum of space for a given capacity. They are widely used in ventilating and air conditioning work.

Backward curved multiblade fans are known as "backward curve," "forced draft," "turbovane," "silentvane," "radial flow," "high speed" and by other names. They are efficient and quiet in operation, and have been used widely as fans for mechanical draft purposes.

The amount of centrifugal force imparted to the air in the fan depends largely upon the ratio of the tangential or rotational velocity of the air leaving the periphery of the impeller to the tangential or rotational velocity of the air entering the fan at the heel of the blades. The diagrams in Fig. 2 represent the parallelograms of velocities for the three general types of blades employed in the design of centrifugal fans.

The air leaving the tip of the blade has a velocity component u, parallel to the blade, and a tangential component u_t. The resultant velocity c is, for the same peripheral speed, greater for the forward curved blade than for the straight

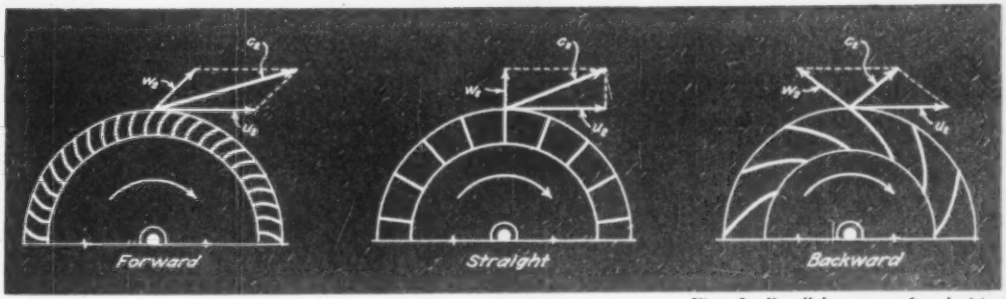


Fig. 2—Parallelograms of velocities for three general types of centrifugal fans

blade, and lower for the backward curved blade. For this reason, the fan with the backward curved blades requires a higher rotative speed than the two other types and therefore it can be directly connected to high speed turbines and motors.

The velocity head developed by the fan wheel is larger than desired; thus, it is necessary to convert kinetic energy into potential energy by decelerating the velocity of the air. The casing is designed primarily for the purpose of collecting the air and to convert velocity head into static head. The efficiency with which this conversion takes place depends upon the proper design of the casing.

How Fan Performance Is Represented

Fan performance is conventionally presented in a graph showing the performance features as a function of capacity for constant speed. Actual characteristic curves are obtained from tests. The test results are corrected to standard air conditions and constant speed; and heads or pressures, brake horsepower, mechanical efficiency and static efficiency are plotted as ordinates against the capacity as abscissa. It is customary to plot performance on a percentage basis instead of using actual measured units. If this is done, one graph will represent to some extent the performance of a series of geometrically similar fans. Therefore, the national code for the testing of centrifugal and axial fans permits for larger size fans of the same design and similar proportions calculation of the performance from tests obtained on fans having a wheel not less than 35 in. in diameter. Smaller fans of the same design and similar proportions, however, do not have the same performance as larger fans, and the performance of fans having wheels less than 35 in. in diameter must always be calculated from tests on fans of the same design and similar proportions and having wheel dimensions not greater than the rated size. (In other words, the fan manufacturer is required to test all sizes from 12 in. up to and including 35 in. wheel diameter.)

Fig. 3 shows the theoretical head characteristic for three cases. The actual head characteristic can be found by considering the head and energy losses that occur in a fan. These losses are usually classified as fluid dynamic, shock and leakage losses. Fig. 4 shows how they can be deducted from the theoretical head-capacity curve to arrive at the actual head characteristic.

It should be noted that in deducting the fluid dynamic losses in Fig. 4, the fan outlet velocity pressure has been included to arrive at curve No. 2, so that curve No. 4 represents, as indicated, the actual static fan pressure p_s; that is to say, the pressure which represents the increase in air potential energy per unit volume gained by the air while flowing through the fan.

The total air horsepower output of a fan (that is, the useful energy added to the flowing gas stream per unit of time) can be expressed as (using either the static or the total head developed by the fan):

$$Ahp_s = 0.000157\ Qp_s$$
$$Ahp_t = 0.000157\ Qp_t$$

where Ahp_s and Ahp_t are the static and the total air horsepower, p_s and p_t are the static and total head in inches of water, Q is the volume handled by the fan in cfm.

The input horsepower to drive the fan (usually called brake horsepower, *Bhp*) has been found in

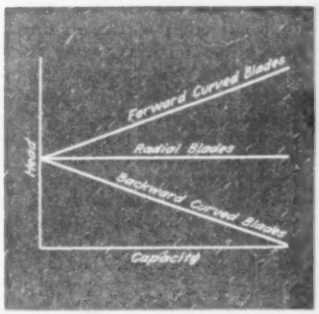


Fig. 3—Theoretical head characteristics of fans

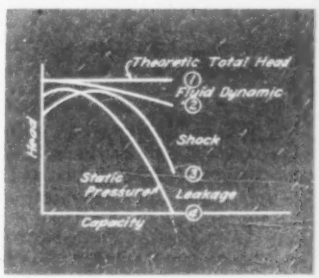


Fig. 4—Losses are deducted from the theoretical head-capacity curve to arrive at the actual characteristic

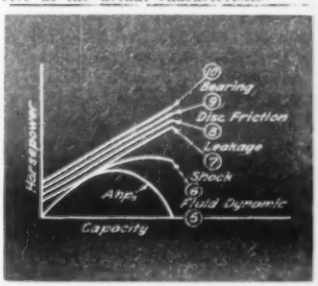


Fig. 5—The input horsepower to drive the fan has been found here by adding to the air horsepower curve No. 5 the energy losses in the fan

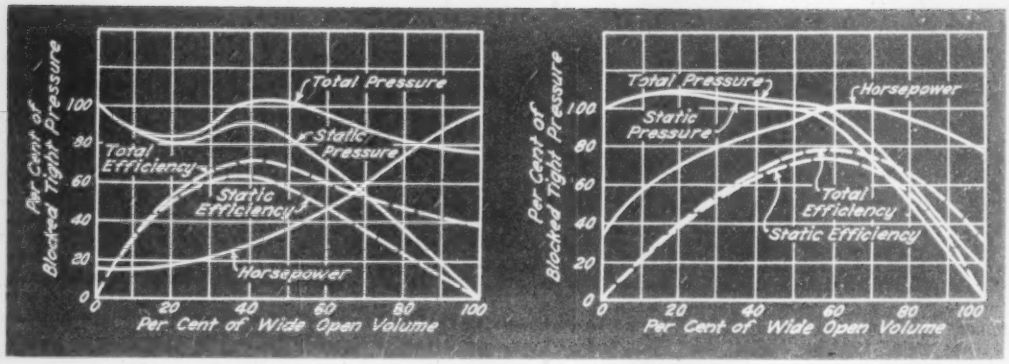


Fig. 6 *(left)*—**Operating characteristics of a fan with forward curved blades. Fig. 7** *(right)*—**Operating characteristics of a fan with backward curved blades**

Fig. 5 by adding to the air horsepower curve No. 5 the energy losses in the fan: fluid dynamic, shock, leakage, disc friction, and bearing. It should be noted that in adding the fluid dynamic losses to curve No. 5, the fan outlet velocity pressure has been included to arrive at curve No. 6, so that curve No. 10 represents, as indicated, the actual brake horsepower.

The mechanical efficiency of a fan is the ratio of the horsepower output to the horsepower input at the fan shaft, or:

$$\eta_s = \frac{Ahp_s}{Bhp} = \frac{0.000157\ Qp_s}{Bhp}$$

$$\eta_t = \frac{Ahp_t}{Bhp} = \frac{0.000157\ Qp_t}{Bhp}$$

where η_s is the static efficiency and η_t is the total efficiency.

Characteristic curves of fans based upon tests made in accordance with the Standard Test Code for Centrifugal and Axial Fans prepared jointly by the American Society of Heating and Ventilating Engineers and the National Association of Fan Manufacturers are generally plotted to show total and static pressure, mechanical and static efficiency, and horsepower in relation to air delivery as a basis. Results may also be plotted against percent of wide open volume or discharge.

Figs. 6 and 7 show the operating characteristics of a fan with forward curved blades and of a fan with backward curved blades. The pressure curves for the forward curved blade have a hump and the horsepower curve rises continuously and is higher at the wide open volume than in the operating range. The point of maximum static efficiency is very close to the point of maximum static pressure and the fan should operate near this point. The pressure curves for the backward curved blade decrease continuously from a point of small volume, and the horsepower curve decreases at the larger volume.

The Laws Governing Fan Performance

The following laws govern the performance of the same fan or of any geometrically similar fan of any size running at any speed and handling gas of any density:

The Same Fan

$$Q_2 = Q_1 \left(\frac{n_2}{n_1}\right)$$

$$p_2 = p_1 \left(\frac{n_2}{n_1}\right)^2 \frac{\rho_2}{\rho_1}$$

$$hp_2 = hp_1 \left(\frac{Q_2}{Q_1}\right)\left(\frac{p_2}{p_1}\right)$$

$$= hp_1 \left(\frac{n_2}{n_1}\right)\left(\frac{n_2}{n_1}\right)^2 \frac{\rho_2}{\rho_1}$$

$$= hp_1 \left(\frac{n_2}{n_1}\right)^3 \frac{\rho_2}{\rho_1}$$

where Q is fan inlet volume, cfm; hp is brake horsepower input; n is speed, rpm; ρ is density, lb per cu ft; subscript 1 is first operating condition; subscript 2 is second operating condition.

Geometrically Similar Fan

$$Q_2 = Q_1 \left(\frac{d_2}{d_1}\right)^3 \left(\frac{n_2}{n_1}\right)$$

$$p_2 = p_1 \left(\frac{d_2}{d_1}\right)^2 \left(\frac{n_2}{n_1}\right)^2 \frac{\rho_2}{\rho_1}$$

$$hp_2 = hp_1 \left(\frac{Q_2}{Q_1}\right)\left(\frac{p_2}{p_1}\right)$$

$$= hp_1 \left(\frac{d_2}{d_1}\right)^3 \left(\frac{n_2}{n_1}\right)$$
$$\left(\frac{d_2}{d_1}\right)^2 \left(\frac{n_2}{n_1}\right)^2 \frac{\rho_2}{\rho_1}$$

$$= hp_1 \left(\frac{d_2}{d_1}\right)^5 \left(\frac{n_2}{n_1}\right)^3 \frac{\rho_2}{\rho_1}$$

where Q is fan inlet volume, cfm; hp is brake horsepower input; d is diameter of fan wheel, in.; n is speed, rpm; ρ is density, lb per cu ft; subscript 1 is fan for which performance is known; subscript 2 is fan for which performance is desired.

The actual point of operation of a fan connected to a duct system is determined by the fan characteristics and the system characteristics. A fan running at constant speed can produce only the combinations of pressure and quantity of air flow indicated on its characteristic curve for that speed as determined by tests or indirectly by application of the fan laws to the test result. The pressure losses in the system vary with the quantity of flow, and the combinations that may exist are indicated by the characteristic curve of the system. Since the pressure generated must equal the pressure losses, only one combination of pressure and quantity will satisfy both the fan and system characteristics.

The typical system characteristic curve follows the simple parabolic law in which the static pressure or resistance to flow of air varies as the square of the volume flowing through the system. Heating, ventilating and air conditioning systems follow this law very closely and no serious error is introduced by its use.

Selecting the Proper Fan

In heating, ventilating and air conditioning installations, the duct

system is usually sized and the fan and fan speed selected under the assumption that air of standard density is to be circulated. The following information is necessary to select the proper fan:

Volume of air to be moved.

Static pressure required to move the air through the system.

Type of motive power available.

Whether fan is only pressure generating source.

The permissible noise.

Nature of the load.

Since the more concise method of presenting fan performance data in the form of ratio charts (Figs. 6 and 7) is practically limited to the use of specialists, the various manufacturers supply so-called multirating tables which usually show the following factors for each size of fan operating against a wide range of static pressures: outlet velocity, fpm; capacity, cfm; rpm; brake horsepower; and static pressure.

The fundamental criterion of a good fan is its efficiency (static or mechanic, depending upon the application). In addition, first cost, the noise emitted by the fan, and the space which it occupies are most important considerations in the selection of a fan. In heating, ventilating and air conditioning installations, noise and the space required for installation are frequently of the utmost importance; in other applications, power consumption may be the foremost consideration in fan selection.

Thirteen Units, 10 HP Compressor, Ice Storage, Cool Baptist Church

THIRTEEN unit conditioners, handling chilled water in the summer and hot water in the winter, furnish year around conditioning to the Winstanley Baptist Church, East St. Louis, Ill.

Individual unit conditioners, containing coils, blowers, dampers and filters were chosen because of their adaptability to the architecture of the church and the space available. The units were strategically placed throughout the church, and are supplied with hot water for heating. It has been found that the church heats in a much shorter time with the new system, and the pastor has stated that the floors were warm for the first time in the history of the church. During winter days when the church is not in use, just enough hot water is circulated to prevent freezing of the pipes and coils.

Chilled water for summer cooling is furnished by four ice storage units served by a single 10 hp compressor. Since the load is intermittent and of short duration, it was found that an ice accumulator and a 10 hp compressor could easily handle it, besides being economical to install. The accumulator is flexible, because additional ice cells to handle more unit conditioners can easily be added in the future. These additions will not require changing the compressor, but a longer time will be needed to build up the required amount of ice.

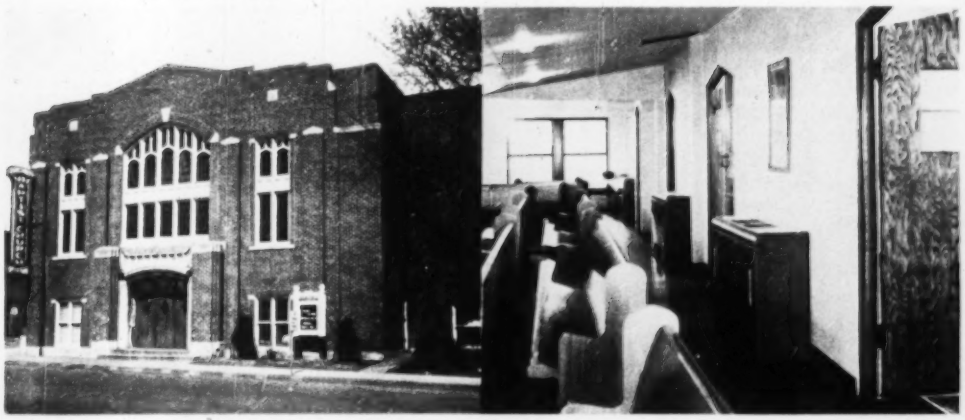
The cooling load runs about 40 tons, with a maximum duration of 3 hr. Five tons of ice is used up during each cooling period and about 12 hr is required to replace it. Only 35 to 45 min is needed to cool the church to temperature.

The noise level of the individual conditioners is held to a barely perceptible level by operating the blowers at low speed.

There is no exposed piping since a full basement allows all piping to come into the units from below.

The system has proved so satisfactory that more additions are being considered, taking advantage of the flexibility of the ice storage method of chilling. Church attendance has increased appreciably both winter and summer since the installation.—J. WADDELL, United States Air Conditioning Corp.

***Left*—The Winstanley Baptist Church, East St. Louis, Ill., is heated and cooled by units furnished with hot water in winter and chilled water from an ice accumulator refrigeration system in summer. *Right*—Three of the units which meet the church's year 'round requirements**



Overhead Finned Radiation Used to Heat Greenhouses

The Angelo Bernacchi and Sons greenhouses at La Porte, Ind., are heated with subatmospheric steam, with much of the radiation of the overhead finned type. This view shows, from right to left, houses Nos. 1, 2, 3 and 4, with the stack of the boiler house in the rear

OLIVER J. PRENTICE describes the heating of the Bernacchi greenhouses at La Porte, Ind., by means of subatmospheric steam and using finned type radiation—overhead in some cases and also along the walls—in addition to bench coils. The Bernacchi organization—comprising a father and six sons and from 30 to 60 employees—has found this heating method of advantage, attributes high tomato production figures to the overhead installation*

GREENHOUSES represent an effort on the part of commercial growers of vegetables and flowers to create conditions favorable to growth in seasons of the year which naturally are unfavorable to outdoor production.

An underlying reason for this effort is the profits that are to be found in the production and distribution of early plants of high quality during the months when weather conditions cut off production and distribution of vegetables or flowers by truck farmers.

The successful growing of plants in the beds and benches of a greenhouse is an art. It is necessary to know—among other things—the behavior of the various species and varieties, and their requirements not only as to soil chemistry, but the air temperatures in which they best thrive for normal growth and for retarding or forcing production to meet varying markets.

*Formerly with C. A. Dunham Co.

Temperature requirements of greenhouses depend upon the plants being grown. Variations of more than a very few degrees have a decided influence on the timing and quality of greenhouse crops. The heat input must vary with the use of the house and the variations in outside weather, including sun and wind effect. Where the use of the house varies with the season, the system should be designed for maximum-minimum heat demands, which vary with the plants being grown.

Salient requirements of a greenhouse heating system thus are (1) a continuous supply of heat at variable rates, so as to eliminate rapid warming and cooling shocks to the plants; (2) dependability of heat supply; (3) flexibility of heat output; (4) economical operation as to fuel and maintenance; and (5) simplicity—that is, a minimum of equipment. Each of these five requirements must be met if the greenhouse heating system is to be efficient and economical.

At the Bernacchi greenhouses at La Porte, Ind., a differential vacuum system of subatmospheric steam heating is utilized for continuous but variable flow of the heating medium. An unusual feature of this installation is the extensive use of overhead finned type radiation for heating such buildings. These greenhouses comprise a first unit of three buildings each 40 ft by 150 ft, and a fourth building 50 by 200 ft. Two additional 50 x 200 ft houses are being built. Steam for heating and sterilizing is supplied by a steel firebox low pressure boiler with an SBI rating of 10,000 sq ft installed in a central boiler house and fired by stoker.

There is a background of four decades of successful truck farming back of this 28,000 sq ft "under

glass" investment, which is operated by a well-coordinated organization of a father and six sons. For 40 years, Angelo Bernacchi was accounted one of the most progressive and successful truck farmers in La Porte county, and he continues operating 150 acres of truck farm during the summer in addition to the greenhouses. The plan to get into year 'round production was conceived many years ago and might be called "a modern youth movement". It was the decision of the father and his sons who, with a long-range viewpoint, decided to cash in on their laborious truck farming experience by adding thereto a scientific education in horticulture. They saw in year 'round production the advantage of retaining the same customers each succeeding calendar year instead of having to resell their truck farm crops each spring to former customers.

A Family Enterprise

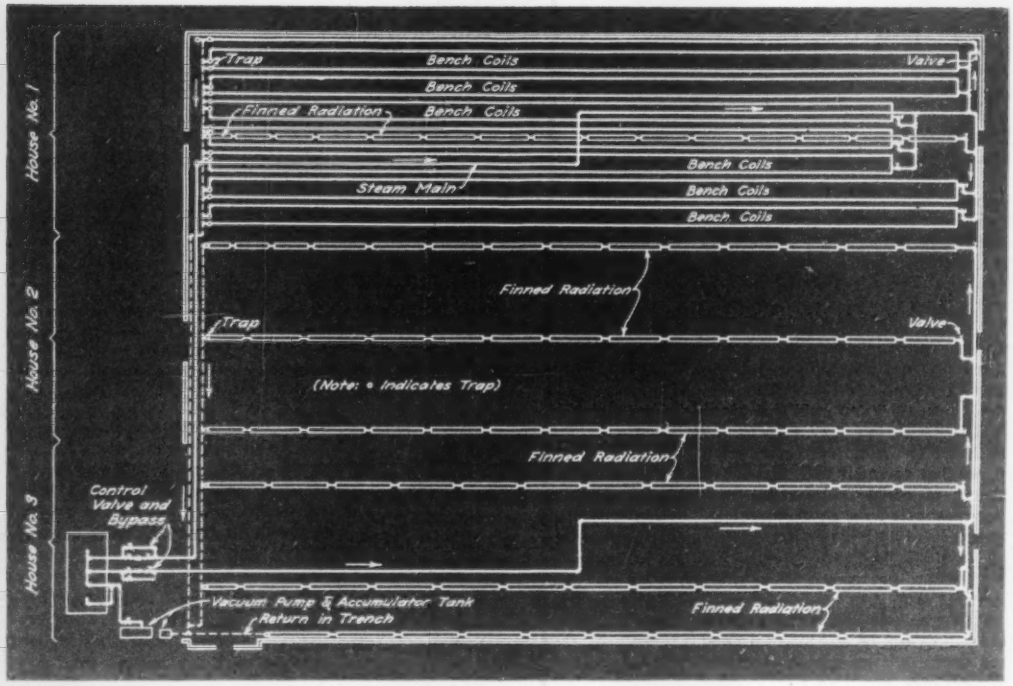
Today, Angelo acts as consultant and supervisor, on the job every day and working energetically with the younger members of the organization. Benjamin and Robert together are general top management in both vegetables and flowers in the greenhouses. Ben, with a degree in chemical engineering from Purdue, is also responsible for insecticides, fumigation, sterilization, mulching, etc., and is in specific charge of the vegetable division. Bob, with a degree in horticulture from Michigan State, is in charge of flowers. Joe, with a four year college course in farming and marketing, directs the sales division. Victor, with a degree in business management, is in charge of the accounting division. Harold, as senior field manager, has responsibility for locating the truck farm crops and timing their planting and harvesting, and is assisted by Bart as field foreman. The number of paid employees per year ranges from 30 to 60.

When the greenhouse investment was conceived, an extensive survey was made of existing greenhouses in Indiana and other states. Construction, operating methods and operating costs were carefully analyzed. A study of accepted heating methods used in greenhouses and in commercial and industrial buildings was included.

The No. 1 Bernacchi house (2109 sq ft EDR), with concrete benches, has customary heating coils on each side of the benches and one row of overhead finned radiation. The No. 2 house (1988 sq ft EDR), originally ground cultivated but now converted to bench cultivation, has no sidewall exposure as it is between Nos. 1 and 3; it has three rows of overhead finned radiation. The No. 3 house (2005 sq ft EDR) has three rows of finned radiation, two overhead and one along the exposed wall. The No. 4 house (3671 sq ft EDR), of the ground cultivated type, has five rows of finned radiation, three overhead and two on the sidewalls. The soil in the ground cultivated houses is steri-

The control panels for the heating in the four houses are in the central boiler room with the stoker fired steel boiler, the 15,000 sq ft vacuum pump, and space for sterilizing soil from the bench cultivated houses

The No. 4 house has five rows of finned radiation, three overhead and two along the walls



Plan view of houses Nos. 1, 2 and 3 showing location of heating surface and piping system

lized with steam after each crop is harvested by tile lines laid well below the ground surface.

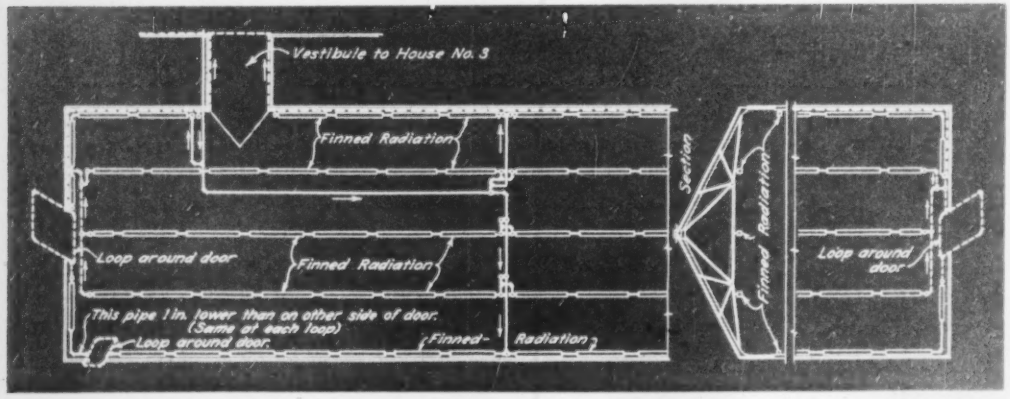
Maintains the Right Temperature

In a recent interview with Mr. Bernacchi, participated in by his sons, he said that this method of heating "has more than come up to our expectations of efficiency and economy. It supplies and maintains the right amount of heat to keep a given house temperature; this is an important factor when sudden drops in outside temperature occur. The temperature of the pipes is kept automatically just hot enough at all times to maintain the right house temperature".

The heating control panels are located in the boiler house and, according to Mr. Bernacchi, since they were first installed and adjusted, the only attention required has been to set the compensator dial knob at the temperature desired.

Mr. Bernacchi attributes his tomato production figures to the overhead heating method. "The state record for this area is 14 lb per plant, the average production being between 8 and 10 lb. Our record last year was 12 lb and the 1950 crop, which will be grown in the 200 ft house, will exceed that—we anticipate 15 lb or more," he said.

Diagrammatic views of the five rows of finned radiation used in the No. 4 house, three overhead and two along the walls



"Tailored" System, Diplomat Operators for Success in Office Air Conditioning

J. DONALD KROEKER, consulting engineer, stressed the importance of the air conditioning installation for an office building being "tailored to fit," and said that the operating engineer needs "some of the qualities of a diplomat" for successful results, in an address at the annual convention of the National Association of Building Owners and Managers in Seattle. In conclusion, he pointed out that there are many opportunities for utilizing otherwise wasted heat in an extensive air conditioning system

AIR CONDITIONING installations in office buildings must be "tailored to fit," and operating engineers should be diplomatic, J. Donald Kroeker, consulting engineer, Portland, Ore., told delegates attending the 43rd annual convention of the National Association of Building Owners and Managers at Seattle. He discussed the factors to be considered in adding equipment for summer air conditioning to existing office buildings already provided with satisfactory heating.

Mr. Kroeker is well known in engineering circles as the designer of the two largest heat pump or reverse refrigeration cycle heating systems in the United States.

Operating Men Must Be Diplomats

Mr. Kroeker stressed the importance of careful selection of operating personnel, as well as of equipment, "since it is representative of a continuing cost and since the character of the operating personnel may have a very definite influence on the amount of continuing cost."

An operating engineer should be selected on the basis of alertness, mental adaptability to new ideas and permanence, Mr. Kroeker said.

It is possible to provide indoor conditions that will be acceptable to about 95 percent of the average tenants, but not to 100 percent, he pointed out. To deal with the 5 percent who are not average, the operating engineer needs some of the qualities of a diplomat.

"It is now the consensus of engineers that a year around indoor temperature of 74 or 75 deg. with air motion of 10 to 25 fpm. and relative humidity ranging between 30 and 50 percent, is acceptable and proper for both winter and summer conditions," Mr. Kroeker stated.

In determining whether air conditioning should be installed, such factors as arrangement of space, climate and public demand need to be considered, he pointed out.

Regardless of climate, air conditioning may be required in deep space, where natural circulation is lacking, and in stores and offices on lower floors, where heat is intensified owing to lights, people or machinery, according to the speaker.

"Dry bulb temperature as read on an ordinary thermometer is not a criterion in determination of areas requiring air conditioning, since comfort is affected very considerably by humidity," he explained. "A better criterion may be given in terms of dewpoint temperature or wet bulb temperature," as recorded by weather bureau stations. "Generally, where the wet bulb temperature occurring annually exceeds 65 deg. air conditioning of office space becomes desirable and must be expected eventually."

When to Install Air Conditioning

When to install an air conditioning system in an office building is a matter that will be determined by public demand, according to Mr. Kroeker. In an area where several buildings have been air conditioned, other buildings eventually will find it expedient to provide their tenants with air conditioning to keep their space rented.

Among various types of air conditioning applications that might be considered for existing buildings, Mr. Kroeker named central duct systems with or without individual controls; central cooling stations with individual room units, receiving chilled water, or low or high pressure pre-conditioned and dehumidified air; and self-contained units.

Though a central duct system is difficult to arrange in an existing building owing to space requirements, it can be provided in many cases, he said. "The most adaptable usually is a horizontal duct system in a corridor with a lowered ceiling, the duct system being supplied with conditioned air from a unit located on the same floor in an existing room, a stair hall, or even exterior to the building in a shaft, with equipment which may be fed by chilled water from water chilling equipment located usually in the basement or on the roof," Mr. Kroeker stated.

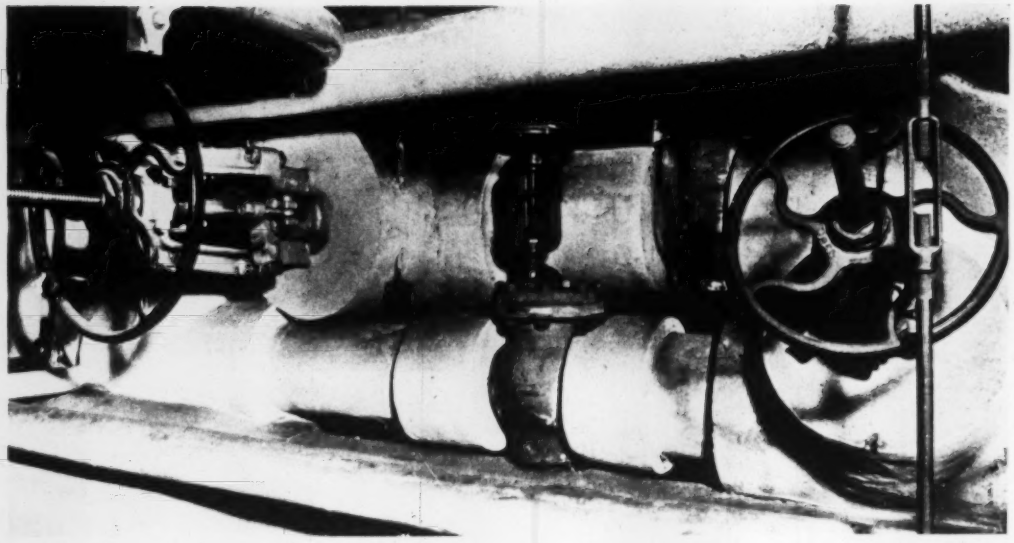
He pointed out that individual room units, supplied either by chilled water or by preconditioned air, offer great flexibility in application in existing buildings.

For conditioning only a part of an office building, he said, it may prove economically expedient to install a self-contained unit, with refrigerant compressors, coils, filters and fans built into it.

Complete analysis of the building to be air conditioned is required to determine the most suitable type of equipment for that particular building, Mr. Kroeker emphasized.

Making Use of Waste Heat

Deploring the economic waste resulting from the lack of recovery of the heat withdrawn by virtually all the extensive air conditioning systems in use today, Mr. Kroeker pointed out that a properly designed system can generally make use of the waste heat. A reverse cycle refrigeration or heat pump system permits the ultimate in recovery, but other types of applications also should find it possible to recover some or most of the by-product heat economically, in his opinion.



Selecting a Control Valve

JOHN PROCOPI, of the industrial division of Minneapolis-Honeywell Regulator Co., gives information on control valve types and characteristics which is aimed to assist users in selecting the correct valve for a specific application. He discusses power units for valves, body members, inner valves and flow characteristics, materials for various services, and the effect of valve size. He points out that oversize valves tend to wear out rapidly

TO APPLY a control valve properly, it is necessary to recognize its capabilities and limitations—to know what it can do, and how it does it. Such a valve may be described as a variable resistance in a fluid flow system. In any automatic control installation, it is as important a component of the system as is the control instrument. The valve must be capable of performing in accordance with the dictates of the controller; otherwise, the installation will be unsatisfactory.

This article is limited to the design and construction features which should be considered in selection of the pneumatic or diaphragm motor type of control valve.

Basically, the valve assembly comprises a power unit or diaphragm motor and the control valve body. Two types of pneumatic operated power units are commonly employed; namely, the spring opposed and the springless diaphragm.

Power Units for Control Valves

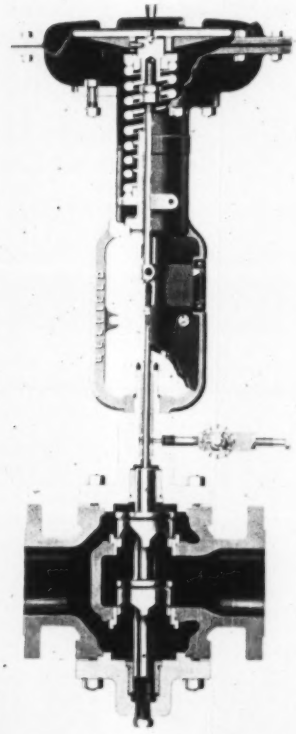
The spring opposed diaphragm motor power unit, illustrated in Fig. 1, has a flexible diaphragm with a pressure-tight chamber on the upper side; to this, the air output of the controller is connected. A compression spring assembly is coiled on the under side of the diaphragm. A stem connects the diaphragm plate to the valve disc. Air pressure applied to the top of the diaphragm creates a force equal to the product of air pressure multiplied by the area of the diaphragm. As the diaphragm moves downward, the spring compresses and creates an opposing force which, when equal to the downward force, results in a balanced position of the diaphragm and consequently the valve disc.

In the design of the diaphragm

motor, certain fundamental principles must be followed. As the spring opposes the air loading pressure, it is desirable that a uniform increment of valve travel or lift be obtained from the energy expended. In other words, the ideal curve—when plotting air pressure on the diaphragm member versus inner valve movement—is a straight line. This characteristic is essential to satisfactory control, to cause uniform variance of the inner valve position with changing loading pressures. The design characteristics also should be such that a minimum of friction is introduced.

Closely allied to friction is the characteristic referred to as hysteresis. This may be defined as the difference between the valve stem position resulting from an increase in air pressure to a given value, and that resulting from a decrease in air pressure to the same value. It is plotted over the entire range of air pressure and stem travel as two curves which form a closed loop.

Fig. 1—A high lift, double ported, spring opposed diaphragm control valve



Excessive friction produces a wide hysteresis loop due to the inability of the control valve to reproduce a given position when the same pneumatic loading pressure is reproduced on the diaphragm.

There are numerous details of design and contruction which must be closely watched if hysteresis in a control valve is to be kept at a minimum. Springs must be well made and carefully selected. Diaphragm material should be as flexible as possible consistent with strength and durability. Machine and assembly work must be of the highest caliber in order to eliminate binding and sticking outside of the stuffing box.

In an automatic control system, the phenomenon of cycling or hunting may be a manifestation of a wide hysteresis loop. For example, if the area of the diaphragm is 100 sq in. and the applied air pressure is 7 psi, a total force of 700 lb acts downward on the valve stem. This force compresses the spring until equilibrium is reached by an equal and opposite reaction and the inner valve comes to rest.

Now, assume that the instrument calls for a new valve position, which position would be obtained by an air pressure of 7¼ psi. This extra ¼ psi gives an additional total applied force of 25 lb on the diaphragm. It is conceivable that a 25 lb opposing force exists in the form of friction in the stuffing box and valve superstructure. In such a case, the valve fails to reach the position called for by the instrument and the controlled variable continues to rise until the instrument raises the air pressure high enough so that the total applied force on the diaphragm overcomes the frictional force. This, of course, causes the valve to jump to a new position which is beyond that required for control, the result being cycling or hunting.

In certain types of valves, a high differential pressure across the valve results in a large stem thrust or unbalance. This must be overcome by the diaphragm motor. There is available for this application a springless diaphragm motor (Fig. 2) whose power is a direct function of effective air pressure and diaphragm area.

The power absorbing spring is eliminated in this motor and the underside of the diaphragm is

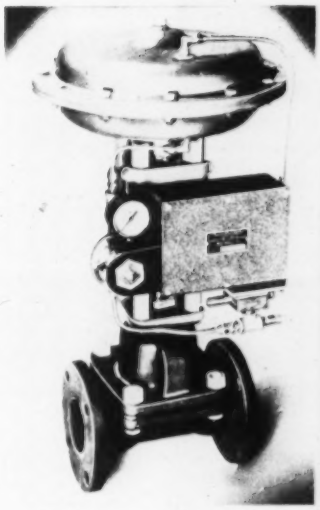


Fig. 2—In this springless diaphragm motor valve, the underside of the diaphragm is loaded pneumatically with a constant air pressure which can be adjusted to suit conditions

loaded pneumatically with a constant air pressure which can be adjusted to suit conditions. The top is loaded automatically, through a force balance type of valve positioner, to any pressure required to hold the position dictated by the control instrument. The loading on one side or the other (depending upon the direction of the thrust) can be set at a minimum, thereby making maximum differential pressure available, across the diaphragm, for overcoming thrusts. For example, if the pressure on the underside of the diaphragm is set at 15 psi, with a 30 psi supply to the positioner, there is available a differential pressure of 15 psi. With an 80 sq in. diaphragm, this amounts to 1200 lb loading.

The Control Valve Body Member

The most common valve body used for control purposes is the globe type, comprising a stuffing box, an inner port and an inner valve.

The stuffing box functions to seal the fluid flowing through the valve body, while permitting the valve stem to pass through as freely as possible. A nut is provided at the top of a sealing gland to permit access to the stuffing box chamber and provide a means of tightening

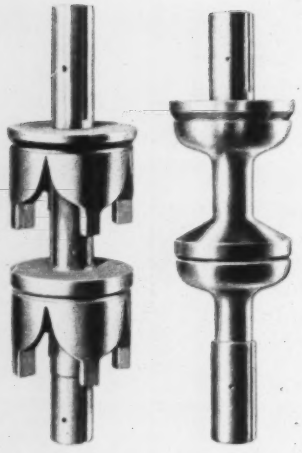


Fig. 3—The linear plug inner valve may be either a V port disc or a solid plug

the seal by compression on the packing material. Since this chamber can be the most serious cause of friction on the valve stem, the packing and lubricant for most fluids should provide an adequate seal with hand tightening of the gland nut. To further promote free action, the stem is highly polished. Good engineering practice accepts packing depth to be six times the diameter of the stem member, with careful construction given to alignments and clearances of glands and other component stuffing box parts.

Temperatures of fluids above 450 F cause excessive drying of the lubricant. For such applications, radiating fins may be used to dissipate the heat before it reaches the stuffing box. Similarly, when fluid temperatures are below 32 F, an extension column may be used to separate the stuffing box from the valve body to prevent stuffing box lubricants from becoming too viscous and also to prevent frosting of the valve stem.

Valve bodies are available in single or double port construction. The inner port is the opening within the valve body into which the valve plug seats to throttle the flow.

In single port valves, differential pressure acts over the entire bottom of the valve plug to create a vertical force on the valve stem. When the valve plug is in the closed position, moreover, the downstream pressure in many applications drops practically to zero. This increases the pressure differential across the valve so that the vertical thrust may constitute an appreciable force. The power unit must overcome this force in order to hold a direct acting (air-to-close) valve closed or to open a reverse acting (air-to-open) valve. For proportional control, the effect of the stem thrust is obviously undesirable.

The double port body was designed to minimize the undesirable effects of this thrust. The inlet and outlet fluid pressures tend to balance themselves by acting both upward and downward on the two valve discs, resulting in what is termed a semi-balanced valve. For practical construction, however, the upper port is usually made slightly larger than the lower so that the lower valve disc may pass through the upper port when the inner valve is installed.

The double port construction has one disadvantage. With variation in temperature, the stem portion connecting the two valve plugs contracts or expands linearly a different amount than does the valve body. In the closed position, therefore, one valve disc seats first and prevents the second disc from seating completely. This results in a minimum or "leakage" flow. Thus, when tight shutoff is required, a single port valve should be used.

Flow Characteristic of Valve

The most important factor in the overall performance of the control valve is the flow characteristic which, in effect, describes the manner in which the control valve acts. The term "inherent valve characteristic" is used to denote the relation between stem position and flow under constant pressure drop. When the drop or pressure differential does not remain constant, as usually occurs in service, the characteristic curve is manifestly modified to provide what is termed the effective valve characteristic.

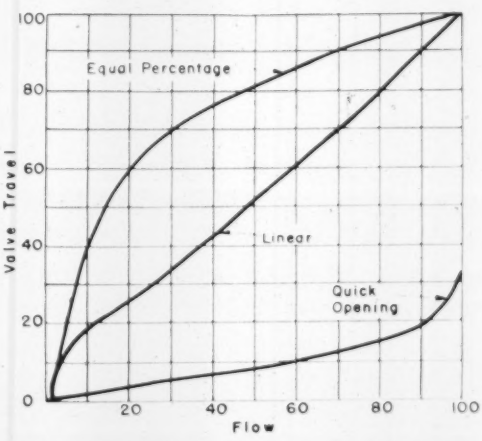
A complete discussion of valve characteristics is beyond the scope of this discussion, which is limited to a description of the more common types of plugs used with control valves plus inherent characteristics.

There are three common types of inner valves: quick opening, linear and equal percentage.

The quick opening type is a bevel seated or poppet inner valve in which the area of the opening is determined by the perimeter of the disc times its valve lift. There are no restrictions after the inner valve leaves the seat, and the valve reaches maximum capacity at a relatively small proportion of lift. This type of valve is generally used for open and shut service.

There are numerous applications where process characteristics are such that adequate control cannot be obtained by a two position valve of this type. Rather, the control element must possess a throttling characteristic or an ability to assume intermediate positions in its full travel, as dictated by the control instrument. This throttling valve must possess a higher lift than the on-off valve, since the higher the lift the simpler it becomes to obtain a characteristic. These so called high lift valves are generally furnished with either of two types of inner valves: linear and equal percentage.

Fig. 4—Flow-lift characteristics for control valves



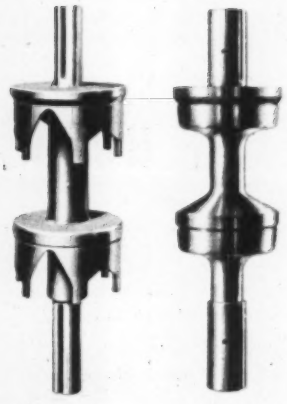


Fig. 5—As with the linear inner valve, the equal percentage disc may be either V ported or solid

The linear plug inner valve may be either a V port disc or a solid plug (Fig. 3). The choice in clean service is largely a matter of user preference. The solid plug is usually a better selection when there is a possibility of plugging or erosion due to the presence of suspended solids in the fluid. The flow-lift plot for this plug is a straight line on rectilinear coordinates, giving equal volume changes for equal stem changes, regardless of percent of valve opening (Fig. 4). This type of characteristic is needed where pressure drop in the system is largely concentrated in the control valve.

As with the linear inner valve, the equal percentage disc may be either V ported or solid (Fig. 5). The flow-lift curve at constant pressure drop is a straight line on semi-logarithmic paper. A control valve with this characteristic will produce a constant rate of change in flow per unit change in lift at constant pressure drop (Fig. 4). This change is always an equal percentage greater or smaller than the flow that existed at the moment preceding the increase or decrease in lift.

In general, the equal percentage inner valve can be used to advantage:

A) Where only a small percentage of the total system pressure drop is available across the valve.

B) When a control valve is in series with pumps, heat exchangers and other resistances. Here, pressure drop across the valve is likely to be low at high rates of flow but high at low flows. Even with variable flow and pressure drop, the equal percentage characteristic provides uniformly satisfactory control at any point of lift in excess of clearance leakage.

C) When operating conditions cannot be determined and it is necessary to install a line size valve. It is rather difficult to oversize a valve with an equal percentage characteristic, which basically has the following capacities:

Valve Lift, Percent	Percent Total Flow at Constant Differential Pressure
25	7— 8
50	12.5— 15
75	37— 40
100	100

It is evident that the greatest percentage of flow is passed during the last portion of the lift. Note that at 50 percent opening, the equal percentage inner valve gives 12.5—15 percent capacity. The linear type, on the other hand, gives about 50 percent capacity at 50 percent lift.

Valve Materials For Service

The design and construction features that are important for proper valve functioning have been discussed. The next factor to be considered is what type of body and trim materials must be used or can be used to handle the flow in question. (For those unfamiliar with the term, trim applies to the lower stem, inner valve, seat rings and stuffing box parts).

Common body materials and their specific application are as follows:

Iron—Up to 250 psi and 250 F, where corrosion conditions permit the use of iron.

Cast Steel—For use where pressures may be as high as 6000 psi and where temperatures do not exceed 600 F. Again, corrosion conditions must permit the use of this material.

Bronze—Pressures to 300 psi and temperatures not exceeding 350 F, corrosion conditions permitting.

Special Alloys—Bodies may be made in special alloys such as acid resisting bronze, stainless steel, etc.

The following are some of the more commonly used trim materials.

Bronze—For low pressure drop across the valve. Generally not recommended over 35 lb pressure drop.

Stainless Steel—Suitable for elevated temperatures and for resisting erosion and wire drawing. The most widely used stainless is 316, an 18-8 steel with 1.75-2.5 percent molybdenum.

Special Alloys—Special alloys are available. Hardened stainless steel (450-500 Brinell) and hard facing on contoured plugs are used to minimize wire drawing and galling.

Effect of Valve Size

Even the most carefully designed diaphragm motor valve will not function at its best if improperly sized. Oversize valves wear out rapidly. A valve which is working too close to its seat tends to wire-draw across the seating surface, resulting in early unserviceability. Valves should be selected from the manufacturer's capacity tables or charts; these exist in various forms.

For example, in the C_v method of valve sizing, the existing conditions (pressure drop, specific gravity, etc.) of the fluid flowing through the control valve are first converted in a reference condition. This is the quantity (gpm) of water at 60 F that will flow through the valve with a pressure drop of 1 psi, and is called the flow coefficient (C_v). After the existing conditions have been converted into the flow coefficient, the valve size is found by referring to a table which shows valve sizes corresponding to the C_v.

There are three formulas for converting the given flow conditions into C_v.

For liquids, $C_v = (Q \sqrt{G}) / (\sqrt{h})$, where Q = quantity, gpm; G = specific gravity (water = 1); h = pressure drop, psi.

For gases, $C_v = [Q \sqrt{G(460 + t)}] / (1360 \sqrt{h P})$, where Q = quantity in cfh at standard conditions of 60 F and 14.7 psi absolute; t = temperature, F; G = specific gravity (air = 1); h = pressure drop, psi; P = upstream pressure, psi absolute.

For steam, $C_v = (Q \sqrt{V}) / (63.5 \sqrt{h})$, where Q = quantity, lb per hr; V = specific volume, cu ft per lb, at the existing upstream pressure (psia) and the existing steam temperature, in F; h = pressure drop, psi.

In the formulas for gases and steam, when the existing pressure drop (h) is greater than 50 percent of the absolute upstream pressure, the given pressure drop is disregarded and one-half the absolute upstream pressure is used for h.

Special Care Should Be Used When

AIR CONDITIONING OPERATING ROOMS

R. A. PHELPS, hospital engineer, has been engaged in the design, construction, operation and maintenance of hospitals—mostly of the institutional type—for more than 25 years. He explains the importance of careful design and installation of air conditioning for operating and anesthesia rooms in hospitals, cites an actual case where troubles were encountered, and gives some practical suggestions to follow

USE OF anesthetics in surgical work is an important reason for air conditioning operating and anesthesia rooms in hospitals. Protection against possible explosions set off by static electrical discharges is believed to be aided by control of the humidity of the atmosphere in the area. It is accepted that such control should maintain temperature between 75 and 80 F and relative humidity from 50 to 55 percent.

In addition to this function of air conditioning, it is also important, of course, to the comfort of the patient and the comfort and efficiency of the personnel.

Extreme care should be exercised in designing and installing such air conditioning systems. Each installation must be designed by competent engineers and installed by skilled craftsmen, because this equipment can be a source of trouble.

Every effort is made to maintain as nearly sterile conditions in the operating room as possible. The entire room, furniture and equipment are constructed of impervious materials which can be thoroughly cleaned. All instruments and textile materials used are carefully sterilized. All persons in the room wear sterile clothing, face masks and gloves. The surgeon makes the incision and exposes the patient's vital organs to the atmosphere. Is this atmosphere sterile?

What is contained in this air? It has passed through filters, perhaps been washed with water and forced by fan blades through metal ducts. Are these filters, fans and ducts sterile? What is the origin of the water? Is it sterile?

Next to the surgeon's hands and instruments, this air is perhaps the most possible source of infection to the patient.

Infections can be caused by minute particles of dust or other foreign substances carried by the air. A microscopic examination of such particles will show that these are highly contaminated. Such particles of foreign matter can get into the airstream from many sources, improperly fitting or dirty filters, oil from bearings, paint, or substances flaking from metal parts of the equipment and ducts.

Trouble Encountered at TB Hospital

This danger was brought to my attention during a recent inspection of a tuberculosis hospital, where the greatest emphasis is placed on sanitation. The surgical staff of this hospital was very proud of the record of no post-operative infections.

This hospital is a single building unit with the boiler house constructed as an integral part of the building. The smokestack extends above the roof.

Recently, an air conditioning system had been installed to serve the surgical suite, including the operating rooms, anesthetization room, sterilizing rooms, nurses' workroom and post-operative ward—all located on the top floor of the building. The air intake is through an exterior wall of the building, as far removed as possible from the smokestack. There is an air filter at this intake. The discharge ducts were built into the ceilings, and entirely enclosed with plaster furring.

Shortly after the cooling equipment was placed in operation, several cases of post-operative infections occurred. In searching for the cause, it was found that a very fine black soot was being discharged through the air conditioning ducts. This soot was examined under a microscope and found to be highly contaminated. The equipment was immediately shut down and examined. The trouble was finally located at the filters. These did not fit tightly in the intake duct, and a small amount of the incoming air was bypassing the filters, carrying with it some of the coal soot. This fault was corrected, the equipment placed in operation again, and no further infections occurred at that time.

Later, the outside humidity lowered and the humidifiers were placed in operation. In a very short time, more post-operative infections occurred and naturally the air conditioning equipment was suspected as being the cause.

The inspections this time, however, showed a very finely divided substance was being discharged into the suite. Again, microscopic examination showed this substance was contaminated. A minute examination was made of all accessible parts of the equipment, but no trace of this substance could be found and the source remained a mystery.

At the time of my visit, as a last resort, the workmen were instructed to tear out a section of the discharge duct. This was done, and it was found that the entire inside surface of the duct was coated with this substance, which flaked off readily when disturbed. I immediately requested to see a chemical analysis of the water.

This hospital is in a city which has long been famous for its water. For many years it has been a health resort, noted for the beneficial effects of its water. The source of this water is four deep wells, located in the four corners of the city, water from each well being pumped directly into the city mains. The water department supplied a chemical analysis of the water from each well, and from a composite sample.

These analyses led to the cause of the trouble, as it was determined that chemicals in the water were reacting with the metal of the discharge duct, under the favorable conditions produced by the moist, warm air. Fine particles, each carrying a load of bacteria, were being forced into open incisions.

From this experience, it can readily be seen that air conditioning of operating suites can be the source of real difficulties. Nothing can be taken for granted in making such installations; every step must be thoroughly studied and worked out. In this case, a widely advertised city water was a dangerous contaminating agent, and necessitated rebuilding of the system, using a suitable alloy metal for duct construction.

I believe the following "rules" should be observed in operating room air conditioning:

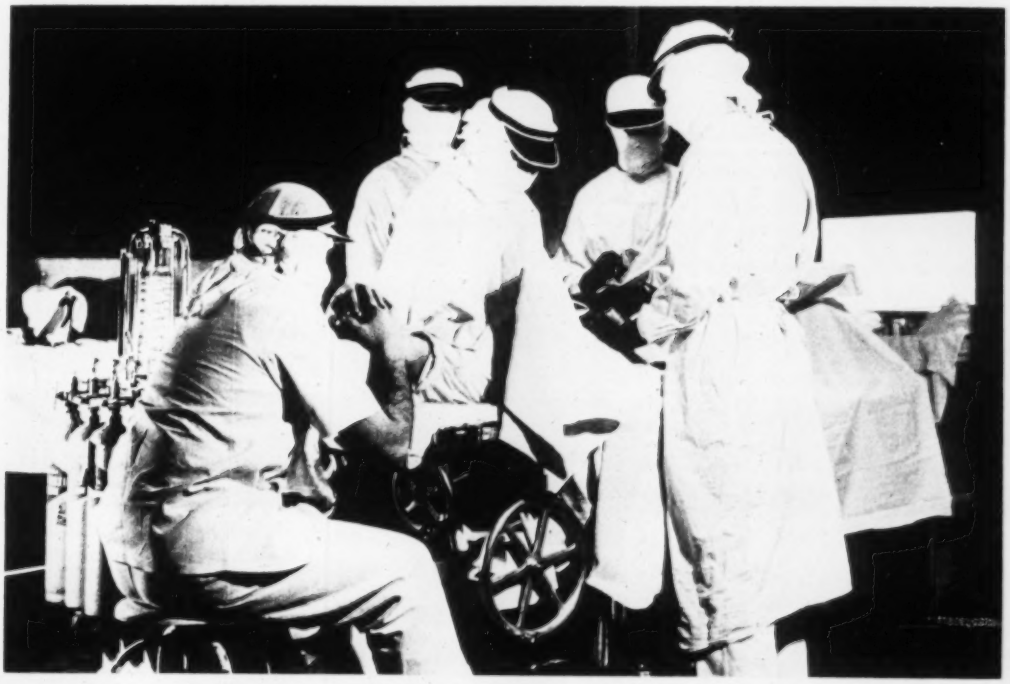
1) Every air conditioning installation for an operating suite is a separate and distinct problem that must be worked out by a qualified engineer, in detail as to every phase of the design.

2) The equipment must be made of the most suitable materials and with the very best workmanship. The filters must be of materials which will not flake or dust off. They must be renewed or washed frequently. The moving parts must be of the proper metals and the housing must be dust- and oil-tight. These housings and the entire duct systems must be of metals that will not react chemically with the water used in the humidifier.

3) The installation must be made by skilled mechanics who realize the necessity of providing an airtight installation and that all parts after installation must be left clean and free from foreign matter.

4) In some installations where the normal water supply is corrosive or has a high solids content, it may be advisable to use specially treated water for humidification.

Air conditioning is important to the comfort and efficiency of operating room personnel



Compressed Air Use Grows in Refineries

RICHARD L. SLATER writes here of the increased use, in recent years, for compressed air in petroleum refineries—for plant maintenance, process maintenance, transferring oil and other liquids, as a "chemical reagent", and for other services. While this development has been "spectacular", indications are that it is still in its early stages, he says*

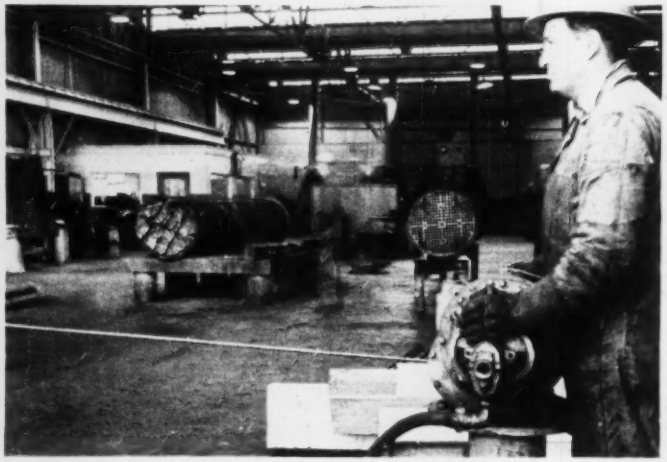
AN IMPORTANT development in petroleum refinery engineering during recent years has been the growth of compressed air as a major utility. Originally confined to the maintenance and repair shops of the refinery, compressed air is today conveyed through miles of piping to almost every corner of the plant, where it stands ready to render service as a power source or in process operation.

The importance of compressed air in refinery maintenance and operation is largely explained by the safety with which it may be used in the presence of flammable oils and chemicals. Perhaps of equal importance is the steadiness of the supply pressure, the ease of piping, the immediate availability of air pressure, and the cleanliness which characterizes operations with compressed air.

Principal power functions given over to compressed air operation involve units which are needed only intermittently. In erection work, hammering, hoisting and drilling operations are carried out by air-powered units to good advantage.

*Consulting engineer.

Air operated winch used to pull heat interchanger tubes at a refinery. Another use for air in this work is to drive the tube with a pneumatic hammer from the other end while the cable is pulling (photo courtesy Compressed Air and Gas Institute)



Considerable importance attaches to the use of an air-operated tube roller which has recently gained vogue in the refinery industry. This unit is used to flare the ends of innumerable tubes throughout the plant in order to hold them firmly in place. The tube roller is inserted into the tube end and is then expanded by air; at the same time, another part of the air-operated tool hammers out the flare to give it permanence. A partial list of air-operated maintenance tools includes such units as impact wrenches, grinders, riveting and chipping hammers. Great popularity has been gained in recent years by pneumatic tools employed for caulking, riveting and other maintenance work on tanks, pipe lines, etc.

The versatility of compressed air is illustrated in refineries, where it is employed successfully for such rugged maintenance functions as outlined above, as well as for the operation of the most delicate control instruments.

Process Maintenance Applications

Process maintenance (as distinguished from plant maintenance) involves the periodic cleaning of numerous processing units throughout the refinery. An excellent means for removing coke and other solids accumulated and firmly adhering to the walls of heat exchangers is the mechanical removal of these obstructions by an air-operated drill. Once the sludge has been broken, it

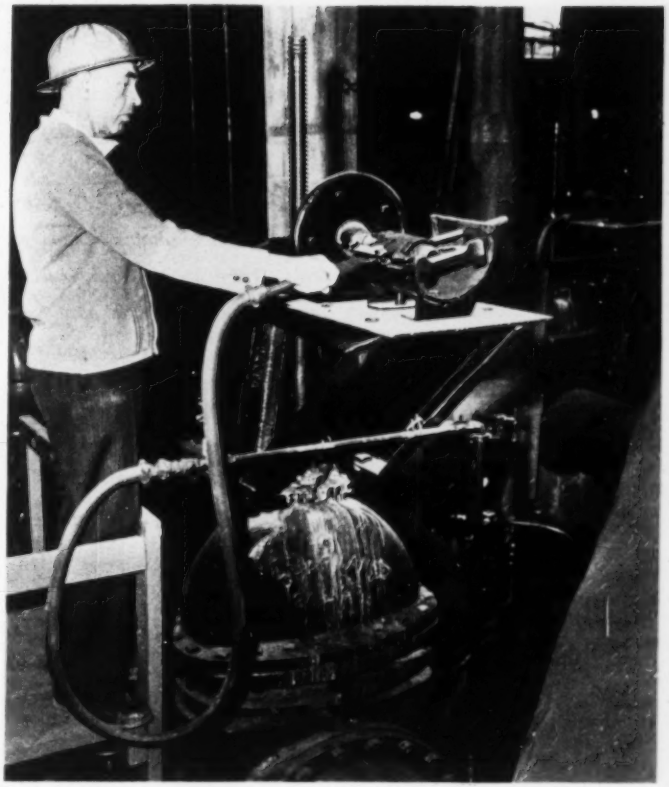
can be removed from the tubes by means of an air-operated brush. Similar tools are used to advantage to clean out the coke which periodically accumulates in distillation towers and lowers their separating efficiency. An alternative means for cleaning coke from such process units involves the erosive action of a sand blast entrained in a stream of compressed air. Sandblasting is similarly used to advantage for cleaning towers before they are welded.

A problem in refinery practice is the periodic clogging of lines carrying asphaltous matter. Unless lines at high temperatures are involved, the deposits are usually comparatively loose and can be dislodged by blowing out the line by means of compressed air. This service finds application not only for asphalt-carrying pipe lines but also for cleaning the tubes of heat exchangers handling heavy bituminous materials.

Used for Transferring Oil in Pipe Lines

The steady pressure with which compressed air can be applied at room temperature renders it ideally useful for a number of process service functions. Important among these is the use of air for transferring oil through pipe lines from one tank to another. This application is particularly significant where the transfer takes place only from time to time and where the investment cost for a pump may therefore not be justified as it would be in the case of continuous transfer operations. Quite often the plant layout involves an initial lifting of large batches of raw material to a storage tank located at a high level by using compressed air (the use of air at 100 psi is common practice in many refineries). From here, the material flows through various process stages by gravity.

No less important is the use of compressed air for conveying corrosive liquids (such as dilute sulfuric acid employed at various sites in many refineries). The use of two or more "acid eggs", operated by compressed air, permits even continuous transfer of such corrosive liquids without imposing any serious problem on the selection of materials of construction. Still another application taking advantage of the constant pressure of a compressed air supply is the use of this power source for the rapid emptying of oil drums. Equally significant is the service use of air for agitating liquids (especially corrosive).



Air motors are used for turning heavy 24 in. valves in the salt water cooling system for refinery units. Similar motors are used for operating swing pipes on storage tanks (photo courtesy Compressed Air and Gas Institute)

With the growing chemical complexity of petroleum refinery operations, compressed air (usually at relatively low pressures) finds increasing application as a "chemical reagent"—for the regeneration of various catalysts (in cracking operations) which have been coated by carbonaceous deposits and have therefore been almost wholly inactivated, as an example. By passing air through the catalyst case under carefully controlled conditions, the coating can be burned off and most of the catalyst's original activity restored. No less important is the regeneration of catalysts employed for desulfurization, which have been deactivated by the accumulation of sulfurous material. In all these cases, resistance to gas flow through the catalyst bed is too great to permit natural convection or even the use of air aspirators and air must therefore be propelled through the unit by positive pressure.

Use of compressed air for the production of specialty products is also important. A discussion of all such applications throughout the petroleum refining industry would perhaps lead too far afield. The typical case of asphalt blowing in which the carbon hydrogen ratio of heavy asphalts is further raised by preferential oxidation for manufacturing a material suitable for roofing compounds, etc., is an example. Typical air rates are 30 to 50 cfm per ton of asphalt handled.

The growth of compressed air use in petroleum refinery practice during the past decade has been spectacular. Nevertheless there are indications that this development is still in its early stages.

NDHA Reports Progress at 41st Annual Meeting

JOHN F. COLLINS, JR., secretary-treasurer of the National District Heating Association, summarizes some of the reports given at the recent NDHA annual meeting which show the progress of the industry during the past year. At the closing session, George H. Tuttle, of Detroit, was inducted as the association's president for the coming year

IN SPITE OF "adverse weather conditions," the district heating industry has shown improvement during the past year largely through an upward revision of rates, which may not yet have had its full effect upon the dollar volume of business, and through the new business which has been added at a satisfactory rate, according to David W. Loucks, of Pittsburgh, retiring president of the National District Heating Association, in his address opening the NDHA's recent 41st annual meeting at Asheville, N. C. There is also further encouragement for future load growth offered through the possibility of building a summer load by developing the use of steam for summer air conditioning, he said.

844 New Customers

In 48 cities in 1949 844 new customers were connected to lines of district heating utilities. These included 190 residential buildings (such as hotels, apartments, clubs, homes and hospitals); 136 office buildings and banks; 276 retail stores and restaurants; 195 industrial and miscellaneous buildings, and 47 meeting places (such as theaters, lodges, churches, auditoriums and schools). Sterling S. Sanford, of The Detroit Edison Co., speaking for the sales development committee, said that these new customers represent an estimated annual steam consumption of 2,348,000 M lb and an annual revenue of $2,376,000. These 1949 new revenue figures are less than those for 1947 and for 1948, which were respectively $2,689,000 and $3,164,000. Of the 844 new customers, 181 had new buildings, 532 had old buildings not previously served and 131 were reconnections.

Although the situation has improved in the past year, in 10 cities there still is insufficient generating capacity and in eight cities not enough distribution facilities to serve prospective customers.

Steam sales of the heating utilities in 1949 decreased 5.7 percent from 1948, principally due to warmer weather. The degree days in 1949 were 6.3 percent less than in 1948. Operating Statistics Chairman Foster Stephens, of Pittsburgh, reported that as a result 18 companies showed a decrease in revenue and the increase for all reporting averaged but 0.09 percent.

Fuel costs continued to climb, but more slowly than in 1948. The increase in cost of the principal fuel, coal, per million Btu over 1948 was 6.31 percent. Likewise, the total hourly wage cost increased 6.30 percent.

Capital invested in the district heating industry increased 3.86 percent in 1949. The proposed 1950 investment is 34.06 percent less than proposed for 1949 a year ago.

A decrease of 10.28 percent in steam loss per square foot of pipe surface was reported.

In concluding his summary, Chairman Stephens said there was an increase of 3.27 percent in the amount of distribution mains on the basis of square feet of external pipe surface.

Slower Trend to Increased Rates

Trends in rates were reported by the chairman of the rates and regulations committee, Clifford O. Thurlow, of Commonwealth Services, Inc., Jackson, Mich. His figures covered 128 separate rates in effect in 88 communities served by 60 companies. The trend toward increased rates continues but at a slower pace than in recent years. Increases in 17 rates applicable in nine cities were reported for the past year, as compared with increases in 35 cities during 1947 and in 32 cities in 1948.

Mr. Thurlow felt that the decrease in the number of increased rates reported probably results from several conditions:

1) A substantial number of reporting utilities already had made appropriate adjustments in their tariffs.

2) High costs have encouraged greater attention to selective load building.

3) Economies made in plant and distribution system operation, together with increases in sales and improvements of load factor, have helped offset increases in wages and other elements of expense.

He said there is "a ray of hope" that the upward spiral of costs is slowing down. There was an actual reduction in the base rate in one city and fuel cost adjustments show a downward trend. A comparison of fuel cost adjustments applicable to steam sold for January 1949 and for January 1950 showed reductions on 43 rates, the average reduction being 26 percent less for January 1950 than for the same month the year before. Twenty-one rates showed increases in their fuel cost adjustment. In these, the adjustment averaged about 18 percent more for January 1950 than for January 1949. In nine rates, there were no changes in the fuel cost adjustment.

Throughout the year, steady progress has been made on the production of the third edition of the District Heating Handbook. The chairman of the educational committee, J. Earl Seiter (of the Consolidated Gas Electric Light and Power Co. of Baltimore) said that while he was disappointed not to be able to report its completion, one-half had been printed, one-quarter of the manuscript was being

edited and the final quarter was nearing completion in the hands of the authors.

The recently-organized past presidents' committee reported for the first time to NDHA. Chairman E. E. Dubry, The Detroit Edison Co., discussed the problem of selecting an equitable financial basis for extending steam lines and services. He had studied the policies of six representative utilities. At some properties, the companies are willing to spend two years' revenue for making extensions. Elsewhere, this varies downward until in one city the customer must pay for the lines; however, refunds are made, depending on the amount of revenue obtained.

Extension costs being higher than formerly, one company is only willing to make short extensions in its territory to increase its percentage of saturation and improve the ratio of revenue to investment.

Methods of Reducing Investment

The second problem reported upon by the committee was that of proved methods of reducing investment. Among the ideas presented were the following:

1) Reduce line sizes.

2) Use one stage pressure reduction instead of two.

3) Rent peak load generating capacity.

4) Increase plant capacity by installing external feedwater treatment systems.

5) Replace older boilers by modern ones of higher capacity.

6) Cooperate with the electric system on plant labor.

7) When increasing generating capacity, build for oil instead of coal.

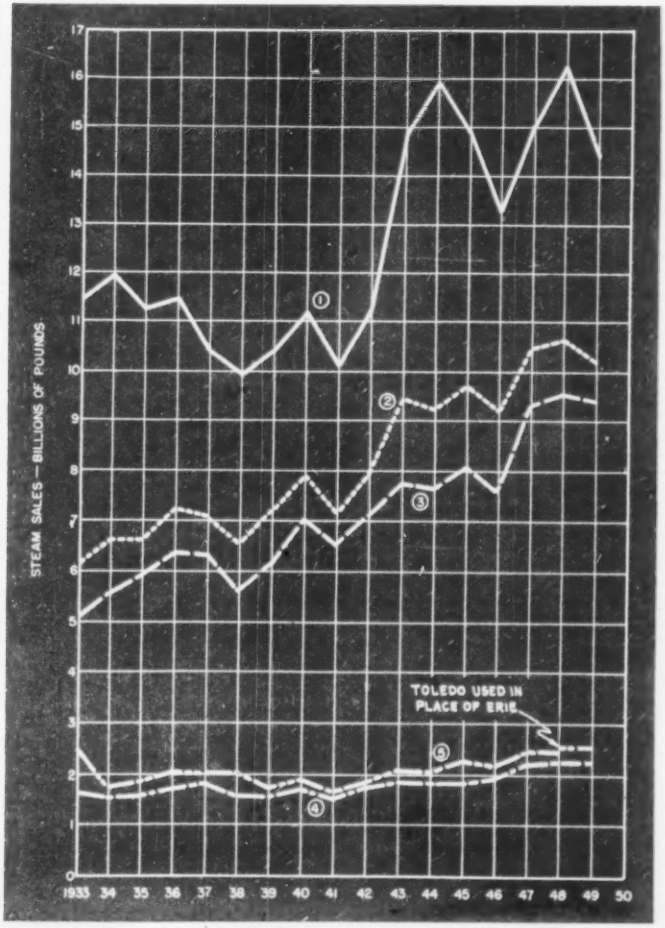
8) When increasing generating capacity, install package type, oil fired boilers with semi-outdoor construction.

The author, reporting as secretary-treasurer on association conditions, said that from the financial and total membership viewpoints, NDHA is in a better position than ever before. He said, however, that production of the new third edition of the District Heating Handbook had consumed so much time of the headquarters' staff—more than 40 percent in the past year—that editing of the annual Proceedings and other lesser items had to be postponed.

The beginning of a long range correspondence program to acquaint prospective members with the activities carried on by NDHA was reported by Membership Chairman Frank B. Mahon of the Allegheny County Steam Heating Co., Pittsburgh.

George E. Whitwell, vice president in charge of sales of the Philadelphia Electric Co., was the guest speaker at the annual get-together luncheon. The subject of his talk was Government's Invasion of the Utility Field.

Steam sales as reported by members of the NDHA, the figures being divided into five groups depending on the volume of annual sales



George H. Tuttle Heads NDHA

George H. Tuttle, The Detroit Edison Co., was elected NDHA president for the coming year; Alfred T. Veness, Rochester (N.Y.) Gas and Electric Corp., first vice president; Percy A. Hyde, Ohio Edison Co., Akron, second vice president; and Charles W. Deeg, Philadelphia Electric Co., third vice president.

Lee C. Killen, The Dayton Power and Light Co.; John N. Voorhees, Georgia Power Co., Atlanta, Ga.; and Fred W. Deutsch, Builders-Providence, Inc., Providence, R. I., were elected to the executive board for terms of two years. Robert D. Martin, New York Steam Corp., resigned from the board and was succeeded by Thomas P. Brown, Jr., also of New York Steam.

This report on the NDHA's meeting will be concluded in a future issue.

PRINCIPLES OF AIR CONDITIONING

WILLIS H. CARRIER, chairman emeritus of the board, Carrier Corp., and honorary member, life member and presidential member of the American Society of Heating and Ventilating Engineers, prepared (with the assistance of a committee appointed by the ASHVE) and presented at the 1929 World Engineering Congress at Tokyo an extensive paper on air conditioning for process and comfort which was published in the November 1929 issue of HPAC. Because of its importance and its thorough treatment of the subject, HPAC's editors recently asked Dr. Carrier to bring it up to date for publication now that "air conditioning has come of age." Those familiar with air conditioning 20 and more years ago will find this a "refresher course", and those unfamiliar with the development of the art in its early days will obtain much of value for present-day use. . . . The first part appeared in the April issue, the second in June

HYGROSCOPIC MATERIALS are those which readily absorb or give off moisture to the surrounding air.

Air conditioning in many industries is largely concerned with the control of the hygroscopic moisture. The moisture content of a hygroscopic material when in equilibrium depends upon the relative humidity of the surrounding air but varies widely for different materials.

The moisture content also varies to some extent for different temperatures at the same relative humidity. The content of hygroscopic moisture is sometimes termed *regain* and is expressed in parts of water per 100 parts of dry material. One of the charts shown here shows the relationship between moisture content and relative humidity for cotton and pure cellulose paper.

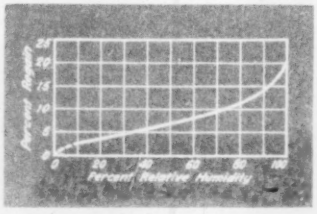
If the material contains moisture in excess of the regain corresponding to any relative humidity, then it will give up moisture to the air with absorption of heat and a resultant cooling effect equal to that of evaporation. On the other hand, if the hygroscopic material contains moisture below that of the corresponding atmosphere, it will absorb moisture from the air with a release of heat which corresponds to the latent heat given off if a corresponding quantity of water vapor were condensed.

Certain chemicals, such as a concentrated solution of calcium chloride, solutions of sulphuric acid, alcohol, etc., are correspondingly hygroscopic and react to changes in moisture in the same way. In certain cases, however, such as with sulphuric acid, there is not only the latent heat of absorption but also a chemical heat of combination.

Air Conditioning and Human Comfort

It has been shown that air conditioning has an important effect on the manufacture and processing of the products in many industries and its effect on human comfort, and hence on human efficiency, is becoming increasingly appreciated. In movie theaters and in the studios producing motion pictures human comfort is a highly important factor, and such structures were pioneering users of air conditioning for comfort. The advantages of air conditioning installations for human comfort are now being particularly stressed in many industries during the summer where the efficiency of operatives would otherwise be generally lowered. Likewise air conditioning is offering stimulus to the summer attendance at theaters and other places of entertainment and business.

Regain chart for Sea Island cotton and paper (cellulose) at 70 F



Attention is called here to the important research engaged in by the laboratory of the American Society of Heating and Ventilating Engineers. Research in this field has been carried on continuously. Very valuable work on other phases of the relation of air conditions to human comfort has also been done under the direction of Philip Drinker, of the Harvard School of Public Health, and others.

The subjects studied in these research programs may be classified under three separate heads.

1. The relationships of the three variables, temperature, humidity, and air motion, to human comfort and the quantitative relationship of these variables one to the other.

2) The determination of zones of optimum comfort embodying these variables in winter and summer.

3) Determination of the relation of sensible and latent heat given off by the human body for various combinations of temperature, humidity, and air motion so that this quantitative data required for the design of ventilating equipment for human comfort in audience halls and theaters might be available.

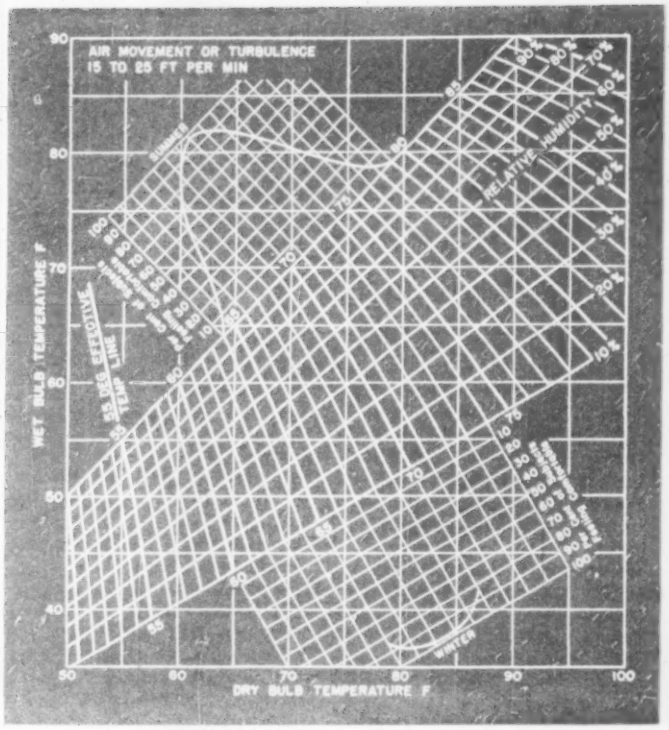
Attention is also called to the work of Dr. Leonard Hill of England who invented the kata thermometer, an instrument which indicates the combined cooling power of the air and surrounding radiating surfaces under various conditions.

The Effective Temperature Scale

It was determined by the investigations of the research laboratory of the ASHVE that in still air there is a definite mathematical relationship between wet and dry bulb temperatures giving conditions of equal comfort. That is, starting with saturated air at any given temperature where the wet and dry bulb temperatures are identical, it was found that the same sensation of warmth could be obtained by increasing the dry bulb and proportionately decreasing the wet bulb temperatures.

Such a series of atmospheric conditions giving the same feeling of warmth when plotted on a psychrometric chart, gives a straight line called an *equal comfort line*. A series of such equal comfort lines may be superimposed on a psychrometric chart. This series of equal comfort lines gives an index of a person's sense of warmth which is called the *effective temperature* scale. The effective temperature of any point on the chart is fixed by the dry bulb temperature of the intersection of the effective temperature line through the point with the saturation curve.

The slope of the effective temperature lines was found to vary with the degree of clothing worn by, and the activity of, a person. The effective temperature scale usually given is for persons normally clothed and slightly active in still air. Similar charts for persons with various degrees of clothing and work in still and moving air have been prepared. In general, the effect of wearing less clothing is to increase the proportionate effect of wet bulb temperature or to swing the lines about their intersection with the saturation curve so as to make them more nearly parallel to the wet bulb temperature lines.



ASHVE comfort chart for still air

Note. Both summer and winter comfort zones apply to inhabitants of the United States only. Application of winter comfort line is further limited to rooms heated by central station systems of the convection type. The line does not apply to rooms heated by radiant methods. Application of summer comfort line is limited to homes, offices and the like, where the occupants become fully adapted to the artificial air conditions. The line does not apply to theaters, department stores and the like where the exposure is less than 3 hours. The optimum summer comfort line shown pertains to Pittsburgh and to other cities in the northern portion of the United States and southern Canada, and at elevations not in excess of 1000 ft above sea level. An increase of 1 deg ET should be made approximately per 5 deg reduction in north latitude.

Dotted portion of winter comfort line was extrapolated beyond test data.

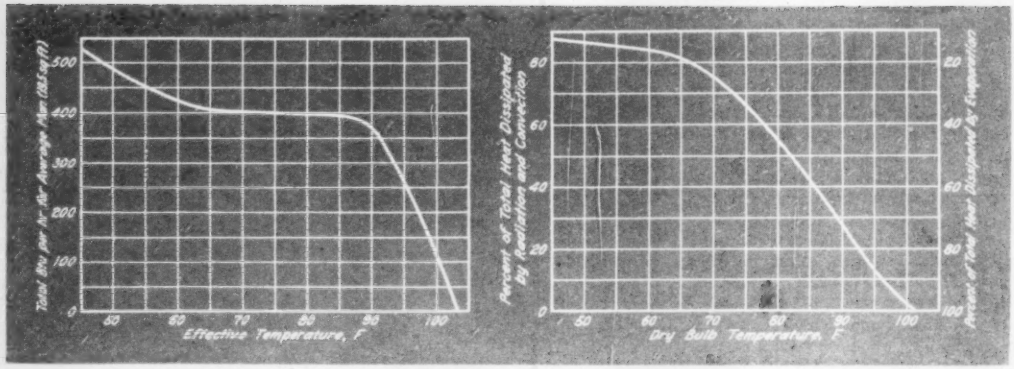
Reproduced by permission from Heating, Ventilating, Air Conditioning Guide 1950.

Air velocity tends to move the effective temperature lines to the right and decrease their angle with the dry bulb temperature lines so that a higher dry and wet bulb temperature is required for the same feeling of warmth with moving air. In all cases, the effective temperature is measured by referring it to the temperature of saturated still air which forms the basis of the effective temperature scale.

The scale of effective temperature is the only index which truly indicates relative human comfort for all conditions of temperature, humidity, and air motion. The dry bulb thermometer alone has little value, contrary to the usual impression. If the humidity is low we must raise the temperature, or if the humidity is high we must lower the temperature, so that for any given effective temperature, many combinations of the dry bulb temperature and humidity are possible.

Research in order to determine the zones of human comfort and optimum comfort conditions for occupied space in winter was conducted by the ASHVE research laboratory. Later research at the Harvard School of Public Health showed that the effective temperature for optimum comfort in winter and summer differ considerably. Optimum comfort requires a higher effective temperature in summer than in winter, due, apparently, to acclimatization and to the difference in clothing worn.

These researches not only indicate the conditions which should be



***Left*—Heat given off per hour for average man at rest in relation to effective temperature. *Right*—Relationship between sensible and latent heat losses for different dry bulb temperatures**

produced by air conditioning systems in procuring human comfort, but also emphasize the necessity of moisture removal from the air on humid days as well as the necessity of lowering the temperature on hot days.

While the comfort chart indicates that the temperature sensation of cooler saturated air may be exactly equivalent to that of dry air at higher temperatures, nevertheless there are other considerations besides the sensation of temperature that are important and should be taken into account. Dampness of the clothing and skin are undesirable; hence, it is advisable to secure comfort in summer by using a lower humidity with a temperature higher than would be required with excessively moist air. In winter, on the other hand, when the moisture content is exceedingly low, comfort is better secured by providing higher humidity than outside conditions would normally give with correspondingly lower temperatures. In this way, the production of dust by electrification, the drying of furniture and the unnatural drying of the membranes of the nose and throat produced by dry indoor conditions normally prevailing in winter are avoided.

Humidity and Air Movement

For human comfort, the range of satisfactory and practicable humidities is between 35 and 65 percent, the latter representing a maximum summer condition and the former a minimum winter condition.

The brilliant work of Ellsworth Huntington indicates that a fairly high degree of moisture in the air is the most favorable. According to his investigations in the dry interior of the United States, a relative humidity of less than 30 percent increases the death rate by at least 10 percent above that which prevails when the relative humidity is 70 percent or higher. He points out that in winter, when outdoor air is heated from about the freezing point to about 70 F, an indoor climate as dry as that of the driest part of the continental interior is produced. Such dryness there in summer causes an increase of at least 10 percent in the death rate, as shown by his tables and charts.

Apart from its effect upon health, humidity, according to Huntington, exerts an appreciable influence upon the working capacity of men. For the same temperature, he found that neither the dry nor the wet days are favorable to the performance of physical labor, but that the best results are obtained with an indoor relative humidity of about 60 percent at temperatures between 65 and 70 F.

Air movement plays an important role in ventilation, not only because it blows away the warm and humid aerial blanket which surrounds the body, but also because it exerts a pleasant and stimulating effect upon the skin, a sensation which is lacking in still air.

According to Baetjer, who studied the influence of air currents on comfort, "currents of air in the threshold of perceptibility contribute to our comfort in all probability by acting on the sensory nerves of the skin, directly or indirectly, and arousing sensations of an agreeable kind." Under ordinary room temperatures this investigation found that the threshold of perceptibility of air currents on the exposed surfaces of the body average in the neighborhood of 4.5 fpm.

Heat and Moisture Losses

Many experiments have been conducted for the purpose of determining the heat evolved by the human body, but the first work which showed the variation in the relation of sensible heat and the latent heat of evaporation to different air conditions was probably done at the ASHVE research laboratory, almost simultaneously with the work of Campbell and Angus, which was carried on in England.

The first of these researches is more thorough than the second and it is applicable to American conditions. It shows that the total heat emitted from the human body at rest varies but slightly under ordinary indoor conditions, averaging about 400 Btu per hr for adult men. It is found, however, that the amount of heat lost by radiation and convection decreases rapidly as the dry bulb temperature rises, while that lost by evaporation is correspondingly increased. The relationship between sensible and latent heat losses for different dry bulb temperatures is shown in two of the charts. These afford valuable data for the design of ventilating and cooling equipment for human comfort. The variation of the amount of latent heat and evaporation at different air velocities is shown in the curve for relation between heat and weight loss.

Neither of these two groups of workers attempted to separate the purely radiation loss from the loss by convection. Data for work of this nature at the Smithsonian Institution, published in 1928, indicate that the heat loss from the human body by convection is roughly one-third less than that lost by radiation, in still air of ordinary room temperatures.

Air Conditions Influence Physical Work

Laboratory data secured in various industries are all in accord in that atmospheric conditions exert a powerful influence upon physical activity.

In heavy physical labor, such as that involved in lifting dumb-bells or riding a stationary bicycle, the New York State Commission of Ventilation found that the amount of work accomplished was 15 percent less at 75 F with 50 percent relative humidity than at 68 F with the same humidity, and 28 percent less at 86 F with 80 percent relative humidity. Vitiated air (23 to 66 parts of carbon dioxide per 10,000 parts of air) appeared to exert a distinctly harmful influence. Temperature and humidity remaining the same, the subjects performed 9 percent less work in the stale air than in the pure air. More complete and thorough data were secured at the ASHVE research laboratory, in cooperation with the U. S. Bureau of Mines and the U. S. Public Health Service, and were reported in 1925 by McConnell and Yaglou.

It will be seen from the curve for amount of work in relation to effective temperature that the maximum amount of work was performed between the effective temperature limits of 40 and 75 F, although the sensations of comfort varied considerably.

In actual practice, Vernon has shown that the output in British factories undergoes a distinct seasonal variation which varies inversely as the mean monthly outdoor temperature. Unfortunately, he did not record the actual air conditions in the factories. One of the figures shows the average relative output in five tinplate mills over a period of seven years.

More striking data were presented by Vernon for British coal mines where the conditions are more severe than in the tinplate industry.

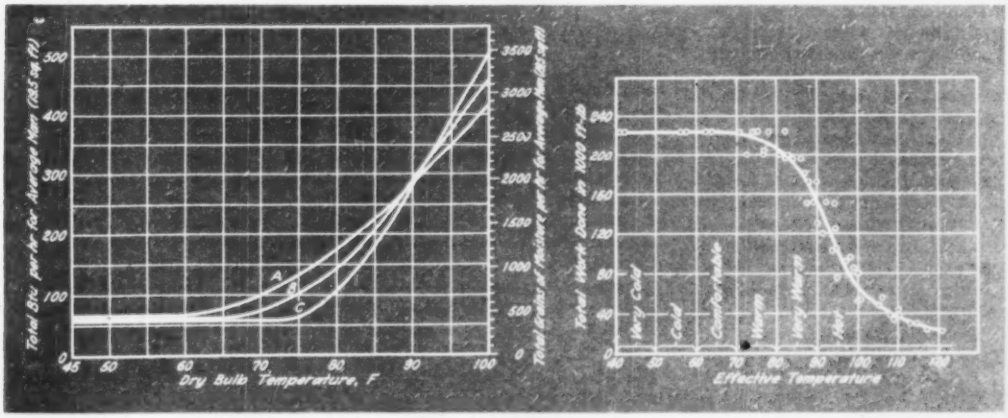
The relation of working capacity in the coal mines as determined by Vernon is shown in the following table:

Effective Temperature F	Wet Kata Cooling Power	Rest Pauses, Min Per Hr	Tub Filling Time, Min	Relative Output, Percent
65.8	18.6	7.3	8.0	100
65.8	14.6	6.7	8.6	94
75.3	12.9	9.0	8.5	91
75.8	10.8	16.0	9.2	82
77.8	9.0	11.1	9.1	81
81.8	6.4	22.4	9.6	59

Other data very similar to these have been obtained by Orenstein and Ireland in the Rand mines in South Africa.

Atmospheric conditions affect also the frequency of industrial accidents. The accompanying chart by Osborn and Vernon shows that the frequency of accidents in British munitions factories reach a minimum at 67.5 F dry bulb temperature, and that they increase above and below this temperature.

Under more adverse conditions, such as those met at the Moro Velho gold mine in Brazil, 20 fatal accidents occurred in 16 months prior to the installation of refrigerating and ventilating equipment, when the conditions underground averaged 101.5 F dry bulb, 87 F wet bulb, and 7.7 wet kata cooling power. During the 16 months after the installation of the equipment, only six accidents occurred, because the dry bulb temperature was reduced to 97.4 F, the wet bulb was lowered to 76.2 F and the wet kata cooling power was increased to 20.5. In addition, the output of the workers increased by 12 percent after the improvements were made.



***Left*—Relation between heat and weight loss from the human body at rest by evaporation, and dry bulb temperature for still and moving air. *A* is for still air, *B* for 200 fpm velocity and *C* for 400 fpm. *Right*—Amount of work performed in relation to effective temperature.**

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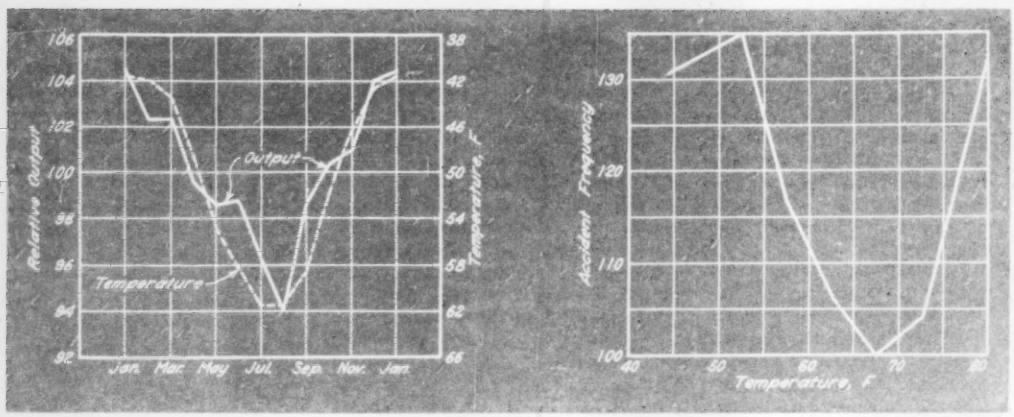
Effective Temperature for Persons



***Left*—Average relative output in five tinplate mills over a period of seven years. *Right*—Frequency of accidents in munitions factories, according to Osborn and Vernon**

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ABSORPTION MACHINES FOR NEW YORK SKYSCRAPER

THE MASSACHUSETTS Mutual Life Insurance Co. building, new New York skyscraper, will be completely air conditioned by means of a rooftop installation of steam-operated absorption machines, according to Carrier Corp.

Four of the machines, located atop the 27th floor of the building at 600 Fifth Ave., will employ district steam from street mains to produce chilled water for the air conditioning system. All outside rooms will be served by a conduit system.

The installation will be largely self sufficient so far as any continuing water supply from outside sources is concerned. Part of the make-up water for the cooling tower, replacing losses due to evaporation, will be recovered from the steam condensate.

Each of the four absorption machines will have a capacity of 275 tons.

Material savings in initial costs are said to have been made possible by the rooftop installation. In addition to space savings through elimination of the usual machine room in the basement, location of the refrigeration units on the same level as the cooling tower will make it unnecessary to install heavy piping for the pumping of condenser water from basement to roof.

The New York Steam Corp. has estimated it would supply approximately 34,600,000 lb of steam annually for the new building.

In the operation of the conduit system, more than 2.6 miles of conduit will carry conditioned air under pressure to a total of 849 outlets, located under each window. Occupants of these offices will thus have individual control.

Interior areas of the building, particularly the first seven floors, or block section, will use the conventional overhead duct system. The air conditioning load will be divided almost equally between duct distribution and the conduit system, with the latter taking over most of the job in the tower section, from the 8th to the 27th floors.

Air conditioning engineers for the project are Jaros, Baum & Bolles.

ASRE Hears Papers on Test Chambers, New Refrigerant, Testing Air Systems

SOME OF the many do's and don'ts in connection with designing low temperature test chambers were contained in the leadoff technical paper presented at the recent 37th annual spring meeting of the American Society of Refrigerating Engineers. Properties and applications of a new refrigerant and the testing and balancing of air handling systems were among other subjects of interest to members.

RECOMMENDATIONS for designing low temperature test chambers were given by W. L. Holladay, vice president, Hieatt Engineering Co., in his paper presented at the recent 37th spring meeting of the American Society of Refrigerating Engineers, in Kansas City, Mo.

By way of introduction, he explained that a test chamber is a "destruction machine," designed to find out how a material or device will react when subjected to extremes of temperature, relative humidity, altitude, and sometimes sunshine, rain, wind, snow, salt spray or dust. In describing equipment which may be required for the more common tests, he said that reduction of temperature is generally accomplished by mechanical refrigeration or solid carbon dioxide. Increase of temperature is generally accomplished by electric tubular or strip heaters, or steam or hot water coils. Mechanical refrigeration has a higher first cost but a lower operating cost than dry ice, and electric heaters have a low installation cost but cannot be used in an explosive atmosphere. Temperature controls used were said to range from a simple single pole-single throw switch reacting to vapor pressure from a sensitive bulb or bellows to complex modulating devices having high sensitivity, satisfactory accuracy and anticipating features.

Mr. Holladay questioned the need for extreme sensitivity for most work, except as a matter of the manufacturer's pride. "We know it can be done," he said, "so we like to keep on doing it." He cited a hypothetical case to illustrate his point that extremely close temperature control is seldom justified. Often, he said, the specifications for the test chamber indicate a singular or unusual temperature. If this temperature is changed from fahrenheit to centigrade, one will probably find it is a multiple of five or ten. In other words, the temperature which one is asked to hold so closely is sometimes just a good round number that somebody picked out of the air.

Good Design Requires Small Temperature "Split"

Getting down to specific problems, Mr. Holladay stated that an element of good design is a small temperature "split" or a small difference between the temperature of the air in the chamber and the refrigerant in the evaporator. This not only requires less addition of moisture on high humidity runs, but on low temperatures especially, a small temperature split means a higher suction temperature and a considerable increase in system capacity. He then pointed out that at a refrigerant temperature of −100 F, a change of 1 deg in suction temperature changes the compressor capacity about 5 percent. In continuing, he said it is important to lay out several possible evaporator and compressor designs in advance to determine the most practical combination. If it is determined that the compressor capacity should be modulated, two curves of compressor capacity are drawn, and the intersections of these curves with that of evaporator capacity are noted. The various refrigerant temperatures are read, the probable point of frost formation can be estimated from experience, and the available capacities at each air temperature can be determined. If one knows the loading of the chamber at each temperature, the running time can be estimated at each air temperature.

According to Mr. Holladay, increasing relative humidity in the test chamber can be accomplished by introducing water in the form of fog or droplets, by introducing steam, or by maintaining in the chamber an exposed surface of water, the temperature of which is at the desired dew point. The last method was said to have some control advantages, but in a chamber capable of being held below freezing the water may have to be dumped, either manually or automatically. "It is important to remember," he said, "that in introducing either water or steam, chamber pressure should be relieved, otherwise testing will soon be done at a pressure higher than that at sea level." He recommended that the use of water spray be effected either by a small turbine or by aspiration with compressed air. Since evaporation is, by definition, a refrigerating effect, the water spray method is especially suitable for low temperature work. While steam works fast, it introduces sensible as well as latent heat, and is more suitable to the upper range of temperatures, according to Mr. Holladay.

High Humidity Means High Vapor Pressure

High humidities in test chambers will mean high vapor pressures

which put a considerable strain on the vapor barrier in the chamber walls. Mr. Holladay said that he would like to be quoted on the opinion that any high humidity chamber ought to be made of walls that are watertight, vaportight, gastight; in other words, the liner should be of welded metal. He recommended that the metal be either stainless steel or monel.

Reduction of humidity was said to be usually a matter of refrigeration and reheat, though very low humidities may be accomplished by chemical absorption or adsorption. In his opinion, the design problems of low humidities at low temperatures are somewhat severe and, fortunately, test specifications rarely call for them, for the very good reason that nothing much happens, at say, 40 F and 10 percent RH. According to the author, manufacturers of test chambers generally limit the low humidity to 25 deg dewpoint, corresponding to a humidity ratio of 19.1 grains per pound of dry air. While lower points can be obtained, it means much lower refrigerant temperatures, a prime surface evaporator, and probable frost problems.

In his opinion, simulating altitudes is merely a question of a vacuum pump that is both good enough and large enough. "There is almost no limit," he said, "to the possible rate of evacuation, if you put a big enough pump on it."

In regard to maintaining low temperatures, he said that —40 F, or possibly —50 F, can be accomplished by single stage compression. In a job of any size, two stage units are required below this, and down to about —100 F, which is the present bottom of most specifications. Mr. Holladay then explained the cascade system which consists of two complete single stage assemblies, connected together through an intermediate heat exchanger which is the condenser of the low stage and the evaporator of the high stage. Two different refrigerants are usually used, such as "Freon-13" and "Freon-22"; or, in the past, ethane and propane. The compressors are generally about the same size and need not be on the same level.

The two stage compound system was also described. This consists of two compressors in series, with liquid subcooling accomplished after the usual suction-liquid heat exchanger, together with intermediate line cooling by water and refrigerant. Only one refrigerant is used, generally "Freon-22" or "Freon-12," and the two compressors must have normal oil levels on the same horizontal line. The low stage compressor generally has two to three times the pumping capacity of the high stage, he said. Mr. Holladay believes the cascade system good for slightly lower temperatures than those provided by the compound system, possibly down to —140 F with "Freon-13" used in the low stage. He said this system is best adapted for fixed temperature chambers, the range of temperatures being limited by reasonable operating pressures and the ability of a refrigerant flow control device to underfeed the evaporator. The equipment is smaller and, in some

How to Heat a Box Car

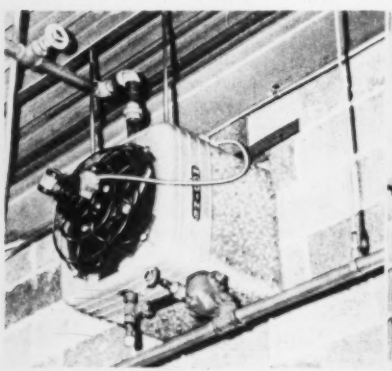
A HORIZONTAL delivery unit heater installed in the shipping department of a manufacturing plant supplies heat to the interior of a box car during winter loading operations. A metal duct connected to the face of the unit heater (at left) is projected through the outside wall and extended across the loading platform (at right) to a point where cars are spotted for loading.

During the winter a removable vestibule consisting of a 2 by 4 frame covered with tar paper extends from the building outward to about 1 ft from the edge of the loading platform. Open spaces between the "vestibule" and the box car are covered with canvas.

Heat from the shipping department is usually adequate to warm the passageway and heat from the unit is delivered directly into the box car, providing comfortable working conditions even in the coldest weather. (In severe climates it may be necessary of course to insulate the duct.)

Metal hangers connected to the canopy extending over the loading platform support the duct high enough to prevent restrictions in normal loading platform operations.

(Photos courtesy Modine Mfg. Co.)



temperature ranges, less costly. He said the two stage compound system is excellent for temperatures down to about —110 F and is flexible over a wide range of temperatures, since the low stage compressor can be stopped and the system operated single stage when required. Although frequently higher in first cost, it was said to be a more practical system for most applications.

Capacity Modulation a Serious Problem

In a test chamber designed for wide temperature ranges, one of the most serious problems encountered is that of capacity modulation. By judicious choice of settings on back pressure controls and a large surge tank, reasonable operating cycles can be attained. Above about 20 F air temperature, one or several of the following means of modulation were recommended: multi-speed motor, bypassing or cutting off half of the cylinders, several evaporators on one compressor, one large and one small expansion valve connected in parallel on one evaporator, several compressors on one evaporator, suction pressure regulation, liquid line flow control for limiting of suction pressure, and a small auxiliary unit for upper temperatures.

One of the common operating problems of a test chamber is the time required to change from one temperature to another. A common requirement was said to be a reduction in temperatures from ambient to the lower limit in two hours, or from ambient to the upper limit in one hour. To reduce the temperature to —100 F in two hours requires careful attention to all elements of design, capacity, ratio between the two stages, evaporator design and basic rating, chamber construction and insulation, air flow, etc. Mr. Holladay pointed out that any method of calculating pull-down time at the design stage of a test chamber requires some experience in the assumptions to be made. The general method, however, is to calculate the heat to be removed from each element of the chamber in going from ambient temperature to the required low temperature. Items to be taken into account include the evaporator, fan, housing and baffles, the air handled, the liner, insulation, framing, windows, fan power input, and any internal load. The sum of the individual calculations is then the total heat required to be removed in order to reduce the chamber to the specified low temperature. A simplifying assumption is then made that the relationship between heat removal and reduction of air temperature is linear. By dividing the total heat by the total temperature drop one obtains a "basic thermal rating." The next step is to prepare a table of refrigerant temperatures and compressor capacities, taking into account the total capacity available at each refrigerant temperature. From a balance diagram one then determines the probable air temperature obtaining at each refrigerant temperature. "It is then a simple matter," he continued, "to calculate the heat to be removed in going from one successive air temperature to another, to divide this heat by the system capacity available at that point, and to add the resulting periods of time, obtaining a total period required to go from the ambient to the lower specified temperature." Mr. Holladay emphasized that this method is subject to weaknesses, that it is somewhat laborious, and that its intermediate points do not agree with actual test runs, due to time lag required for heat to conduct and convect to the evaporator; but the totals are accurate and on the conservative side, he said.

Leave Nothing to Chance

In speaking of the operation of a low temperature chamber, he stated that nothing should be left to chance, as the adjustments of the various components are delicate and are, to a considerable degree, dependent on each other. For example, large compressors tend to run hot in these applications and oil must be cooled. The intermediate line should be cooled to between 50 and 60 F. The large, low stage compressor must not be started until pressures have been reduced by single stage operation. Refrigerant must not be over-fed to the evaporator, or liquid will frost over the compressor in a matter of seconds. Oil separators were said to be an absolute necessity and the oil used should be of the type that will not solidify at the expected operating temperatures. In his opinion, the standards of cleanliness and dryness must be at least as good as the best hermetic unit production line, for one must attain a dew point within the system well below the lowest expected refrigerant temperature. Generous sizing and conservative designs were said to pay off in satisfactory capacity.

At the conclusion of Mr. Holladay's presentation, Edward Simons, ASRE vice president, asked the author what methods he used for defrosting and how he prevented moisture from getting in the chamber through the exhaust systems of those installations where ventilation is required for occupants. He also asked about the effect of frictional resistance on pull-down and balancing of the refrigeration system. In reply, Mr. Holladay said that defrosting generally is not a problem because ventilation is seldom required and the use of electric defrosters has been satisfactory. He also said that the best way to eliminate moisture from entering through the ventilation system is to get people out of the space, particularly when it is at —100 F, and to eliminate the ventilation. Mr. Holladay admitted that his balance diagram is only approximate and ignores several factors.

Testing, Balancing Conditioning Systems

Testing and Balancing Air Conditioning Systems, by L. R. Phillips, director of research, Anemostat Corp. of America, was the next paper to be presented at the first technical session of this meeting. Mr. Phillips led off by outlining specific information regarding the particular job which must be known by the test engineer before balancing or testing is started. This information includes data on the design of the particular system, acceptable noise levels, and catalog data on fans and equipment used. General knowledge which the test engineer must have was said to include the fan laws, the relationship between static and velocity pressure, air duct friction, air flow through various types of outlets, and physiological aspects of comfort.

Mr. Phillips then briefly described instruments used to measure static pressure, velocity pressures, duct velocities, and velocities at discharge outlets. These include the direct reading air velocity meter, pitot tube, moving vane anemome-

ter, and thermo-anemometer. It was pointed out that some measuring instruments have directional characteristics which are different from other instruments, hence, trouble may be encountered with turbulent air or when air direction has not been established.

In conclusion, Mr. Phillips described the step-by-step procedures for properly balancing systems.

Refrigerant Provides Increased Capacity

The next paper, presented by C. M. Ashley, chief development engineer, Carrier Corp., was a report on the performance and application of the newly invented refrigerant, "Carrene-7."

Mr. Ashley emphasized that the new refrigerant is the result of a research project carried out by his company in an effort to find a refrigerant which would fit a number of specific requirements. He reported that field and laboratory tests indicate that "Carrene-7" will meet refrigeration capacity and horsepower requirements of 17 to 18 percent more than "Freon-12" for a given compressor displacement. The new refrigerant, he said, should be "especially useful" in the following situations: filling job requirements falling between existing compressor capacities; matching additional motor sizes within and beyond the "Freon-12" compressor line for air conditioning loads; utilizing full motor capacities for commercial refrigeration; increasing the capacity of an existing installation; and raising the capacity of 25 and 50 cycle systems to equal the 60 cycle system using "Freon-12."

Not yet available commercially, the new product was invented by Dr. W. A. Pennington, chief chemist and metallurgist at Carrier, and W. H. Reed, former Carrier fellow at Syracuse University. After setting up the specifications of the desired refrigerant, they studied virutally all compounds and found that none would be satisfactory. They then turned to compound mixtures but found that this was not the answer, i.e., a simple mixture of two refrigerants. What was needed was an azeotropic (constant boiling point) mixture. An azeotrope cannot be separated by distillation, etc., and a mixture of water and alcohol is, perhaps, the best example of an azeotrope. After developing certain new techniques for measuring specific volumes, etc., desired characteristics were found in a mixture of "Freon-12" and "Genitron 100."

Mr. Ashley reported that the new refrigerant operates at approximately 18 percent higher pressure than "Freon-12" at the same temperature and that refrigeration systems must be suitable to withstand this pressure. He added that "Carrene-7" had met design objectives as to high chemical stability, had proved nonflammable at reasonable temperatures and had passed satisfactorily through tests for toxicity and corrosive qualities. Describing direct comparative tests between the performance of a 5 hp compressor using "Carrene-7" and "Freon-12" under identical conditions, he stated that the new refrigerant showed a capacity of 17.5 percent more than "Freon-12" and a power input of 17.3 percent more when running at 1750 rpm.

A further laboratory check on relative performance was made on a 3 ton self contained unit, he continued, with the "Freon-12" compressor operating at 60 cycle speed and the "Carrene-7" at 50 cycles. According to Mr. Ashley, the "Carrene-7" test at the 50 cycle speed showed slightly better performance than the "Freon-12" at 60 cycles.

In the course of an extensive program of field testing, 32 existing systems, varying from $\frac{1}{4}$ to 40 hp, were charged with the new refrigerant. These systems included both air and water condensing units and were for both refrigeration and air conditioning duty. Some of the equipment was operated up to 4000 hr over a two year period and several units were on 24 hr life test. "This program," said Mr. Ashley, "permitted our engineering staff to develop satisfactory application techniques and to broaden our experience as to the practical value of the refrigerant. The results of the program have been highly satisfactory and there has been no difficulty attributable to the refrigerant with any of the installations." As a second step, a broader field program was initiated in which a limited quantity of the new refrigerant was made available to a selected list of dealers. Results so far, he reported, have been gratifying.

In discussing the application of the refrigerant, Mr. Ashley said that if the full increase of approximately 18 percent in capacity is to be realized, it is necessary to provide approximately 18 percent increases in the capacities of all other elements in the system other than the compressor. He added, however, that in some existing systems it might prove advantageous to change the refrigerant only, without changing the physical system. For evaporator temperatures in the range used for comfort air conditioning, he indicated that "Carrene-7" can be used with expansion valves designed for "Freon-12" by a readjustment of the setting. He also stated that the moisture solubility is several times greater than that of "Freon-12" and that there is less danger of difficulty due to the precipitation of moisture in the form of ice. He indicated, however, that it is still advisable to maintain the same standards of dehydration of the system as with "Freon-12."

During the discussion, D. D. Wile, chief engineer, Refrigeration Engineering, Inc., suggested that the discovery of the new refrigerant might open up possibilities for other similar discoveries, particularly for refrigerants having better flow and heat transfer properties. Such refrigerants, he added, would afford economies in piping.

M. W. Garland, Frick Co., suggested further tests to determine miscibility at different evaporative temperatures. He also inquired as to the superheat characteristics.

In reply to Mr. Wile, the author, who had previously indicated that cycle efficiency is related closely with the molecular weight of refrigerant, said that there is a limit caused by superheating problems to low molecular weight. In other words, as the molecular weight of the refrigerant goes down, cycle efficiency goes up, but superheating problems indicate a limit to low molecular weight. He also indicated that the possibilities of other refrigerants are open but he believes "Carrene-7" fills a real and immediate need. In reply to Mr. Garland, he said that his paper is merely a progress report and that additional data are being obtained.

This concludes HPAC's report on the recent ASRE spring meeting. The water conservation conference, an important part of the meeting, was summarized last month.

Insulate at Pipe Hangers for Efficient Processing

GAPS IN INSULATION at pipe hangers are often a "weakness" in otherwise well-insulated hot or cold lines. In the novel technique described here, boxes made of insulation board and stuffed with loose insulation are used to protect these vulnerable points from excessive heat absorption in cold lines or excessive heat loss from hot piping

AN ALL-TOO-FREQUENT weakness in otherwise carefully insulated pipe lines is the succession of gaps around pipe hangers. Such exposed pipe surfaces cause heat absorption in cold lines, or heat loss from hot lines. Also, in cold lines, condensation at bare pipe sections may cause moisture to creep under the insulation and, by wetting, result in even more unnecessary heat absorption.

Mineral Wool Board Boxes

Unique boxes, constructed of mineral wool boards and stuffed with loose mineral wool, have successfully corrected this weakness along a brine line at the Iron City brewery of the Pittsburgh Brewing Co. Application of the new technique prevents brine, at 24 F, from absorbing heat at vulnerable pipe hanger points and eliminates the possibility of destructive moisture condensation.

Each insulating box is formed by cutting 3 in. mineral wool boards to fit around existing pipe insulation and the pipe hanger. The boards are then fitted together and fastened with skewers. To provide added insulation, loose mineral wool is packed into the box to a density of 9 lb per cu ft. The boxes (four are visible in the photo) are next vapor sealed with wax impregnated fabric and rosin sized paper, and finally finished with an 8 oz canvas jacket.

Insulating the Piping

The piping itself, running from brine tank to stock house, is insulated with 3 in. molded mineral wool pipe insulation. The sectional insulation is applied in two $1\frac{1}{2}$ in. layers, with the sections staggered so as not to line up joints in both layers. By tightly spiraling jute twine around the insulation, the first layer is pressed into a thick coat of asphalt mastic trowelled onto the pipe surface. The second layer is similarly secured over a coat of mastic trowelled onto the first layer, and the insulation is finished in the same manner as the mineral wool boxes.

Though applied here to prevent heat absorption and moisture condensation in a cold brine line, this insulating technique can be adapted to heated lines carrying steam, petroleum derivatives or industrial chemicals—and to other low temperature lines in air conditioning, cold storage and process piping systems.

Unique boxes made of mineral wool boards and stuffed with loose mineral wool insulation prevent excessive heat absorption at the pipe hangers which support this brine piping at a brewery

Sam Lewis' Page

INFORMAL COMMENT on heating, piping and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors.

TWO BOILERS WITH DIFFERENT WATER LINES

THERE HAS been presented another interesting solution to a problem which was discussed in these pages some months ago. This problem was how to make two differently designed boilers, having normal water levels $18\frac{5}{8}$ in. apart, operate as a team on a gravity circulation steam heating system. My own argument was to the effect that the most practicable answer would be to install automatic water level controllers and a condensate pump, or to reset one of the boilers at a new level so that the $18\frac{5}{8}$ in. difference in water levels would be eliminated.

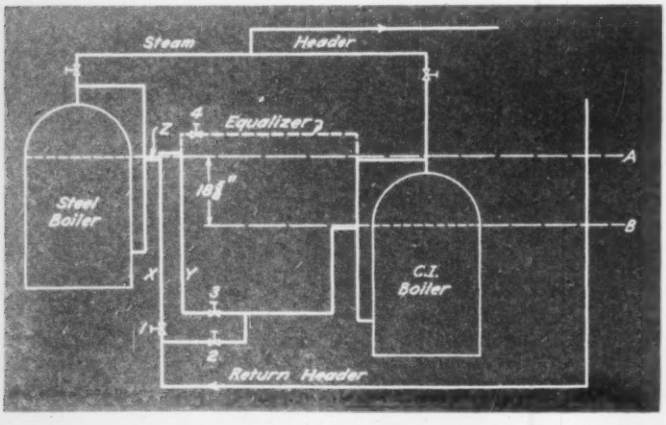
The accompanying sketch shows a solution submitted by R. V. Garner, of The Frank A. McBride Co., heating contractors. According to it, the water level in the wet return main would be at *A*, and all condensate would flow to the higher steel boiler through riser *X* and from it at *Z*. It would then flow through drop riser *Y* through open valve *3* to the loop and into the lower cast iron boiler. Valve *2* would be closed, and valve *4* in the equalizer pipe would be open. If the lower boiler is to be operated alone, valves *1*, *3* and *4* would be closed, valve *2* would be opened, and enough water would be wasted to the sewer to drop the water level in the return main to level *B*.

It appears that this scheme might work. Mr. Garner suggests, however, that he would not advise making a permanent installation in this manner because of the probable difficulty in maintaining an acceptably stable water level in the cast iron boiler. My own comment is that the manipulation of the correct valves in proper sequence would involve a considerable risk.

For example, when switching from the steel boiler to the cast iron boiler, valves *1*, *3* and *4* must be closed before valve *2* is opened, and the drain valve on the cast iron boiler must be opened just enough to care for the condensate that otherwise might flood the cast iron boiler. The steam valve of the steel boiler would have to be closed after the production of steam from that boiler has ceased. When reversing the situation, so as to operate both boilers, valve *2* must be closed first. Then new water must be admitted to the steel boiler to bring up the water level in the return main to level *A* before the water in the steel boiler falls below the danger point.

This solution from Mr. Garner is interesting, but I feel—as does he—that the lower boiler would be left in a precarious situation.

Mr. Garner suggests this as a theoretical solution to the problem of connecting the two boilers with different water lines, agrees with Mr. Lewis that it would not be advisable to operate in this way



HOW TO CONNECT A CONDENSATE PUMP

I RETURNED recently from a long trip and, despite the pressure of catching up with my affairs, I succumbed on my first day back at the office to an emergency appeal to speak to a large gathering about "Experiences of an Engineer."

While by no means pious, I have always felt the benefit of prayer. It seems to help psychologically, as it did the carter in the fable when he called on Jupiter for help to pull his vehicle out of the mud. Jupiter thereupon appeared in a cloud and promised to help if the carter would put his shoulder to the wheel and would whip up his steeds. So perhaps Jupiter made me talk, in this emergency, about how to connect a condensate pump to combat the influence of induced vacuum, and as the audience seemed interested, my problem apparently was solved.

The pump must receive the hot condensate from a low pressure steam heating system and must return the water to the boiler. The condensate will not emerge from the radiation unless the steam pressure in the radiation is higher than that of the atmosphere; but it is desirable that the steam pressure in the radiation be not appreciably greater than that of the atmosphere, lest there be difficulty with automatic air venting valves. The usual piping arrangement is for the condensate to flow through a trap to a receiving tank that has an open vent to the atmosphere. The water then can flow by its own weight into the pump and the pump can operate intermittently as a liquid level control in the water of the receiving tank opens or closes a switch.

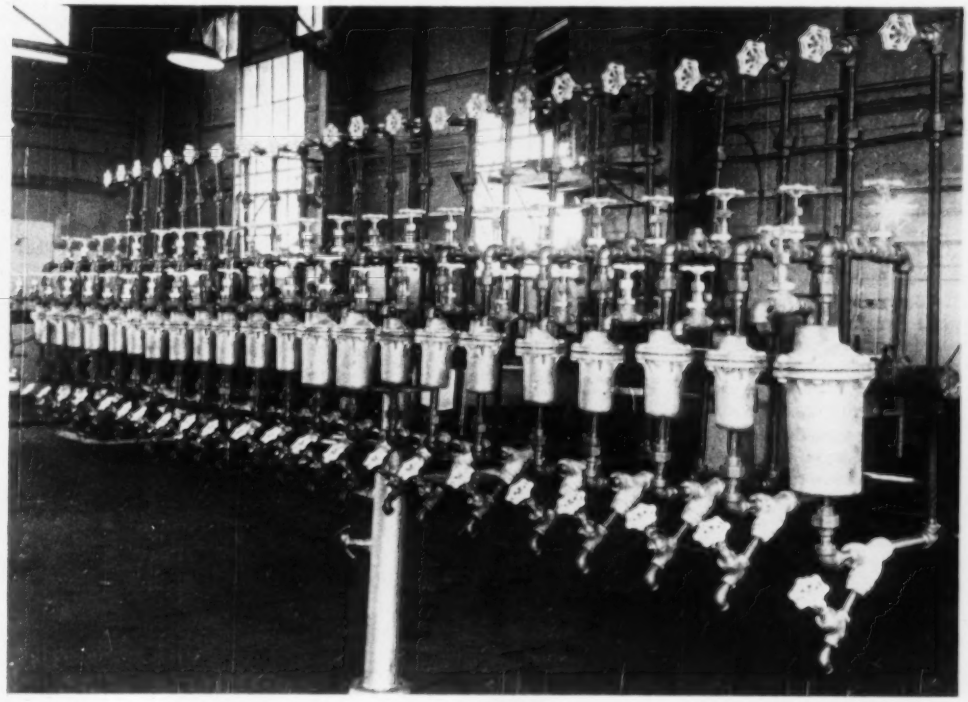
However, steam pressure is not always constant in the heating system. If the demand for heat is great or if there is any throttling of the steam supply, the pressure

"Planned Piping" for Steam Trap Assembly

PLANNED PIPING could well be the title of this photo, which was taken in the pipe shop of the Bridgeville plant of the American Cyanamid Co., according to T. H. Rea of Armstrong Machine Works. The complete assembly of piping for the steam traps and return line is made here and then trucked out into the plant where connections to the traps are quickly made.

Note how this hook-up conforms with the Code for Pressure Piping and then some. On the inlet and outlet, valves permit shutoff for inspection or removal of the trap. A Y-type strainer is provided with a blowdown valve which can be conveniently used to clean the strainer. The trap itself is provided with a test valve outlet for a quick check of operating condition. A check valve is located in the discharge line from each trap.

The result is a neat, uniform installation which requires a minimum of installation and maintenance time.



Complete assembly for steam traps and return line is made in the pipe shop and then trucked out into the plant, where connections to the traps are quickly made

within the heating system will fall below atmospheric. Then the condensate eventually will fill the heating system and will not accumulate in the receiving tank to such an extent as to influence the controller and start the pump. Eventually, the water level in the boiler may become dangerously low.

Due to the induced vacuum in the heating system, air relief valves will close tightly or may permit air to flow back through them. The suggested answer to this trouble is to install a bypass pipe around the trap, with a swing check valve in the bypass, faced so that the check will normally be closed but may open in case of induced vacuum, thus permitting entry to the heating system of air and vapor from the receiving tank. Thus, the pressure on both the outlet and inlet of the trap will equalize.

Of course this scheme turns out to be, in the final analysis, merely a vacuum breaker but the location in the bypass seems favorable, a swing check is not costly, and will be out of business—doing no harm—as long as the heating system pressure is higher than atmospheric. If for some reason it is desired to maintain some pressure higher than atmospheric in the receiving tank, the scheme of equalizing the pressure around the float trap still will work.

There are cases where the return main from the heating system must be higher than the radiation, as in coils that warm the air used for ventilation and where a vacuum pump is expected to lift the condensate. The check valve in the bypass around the vacuum trap on each section of indirect heating coil can be employed in such cases.

QUESTION of the Month

IN THIS regular feature, specific questions on heating, piping and air conditioning which have been asked by HPAC's readers are answered both for the original "asker" and for others as well. The editors hope you'll find these practical comments of regular monthly interest, will contribute either questions or answers yourself when the occasion arises.

CROSS CONNECTING REFRIGERATION MACHINES

ANSWERING THE question from "R.A." about the operating problem in one of his air conditioned buildings, which was published on page 109 of the July HPAC, it is perfectly practical and hundreds of systems have been installed cross connecting "Freon" reciprocating compressors in multiples of from two to five or six compressors. Most important in this cross connection is the installation of oil equalizer lines between the crankcases of the compressors. This requires a line below the oil level as well as above the oil level; it must be of adequate size so that even the smallest pressure differential will be negligible. By the same reasoning, suction and discharge lines must be cross connected with proper manifolds.

The use of oil separators in the discharge line is somewhat questionable because "Freon" is so miscible with oil it is difficult to separate without considerable change in temperature or velocity. It is true that some oil is taken out by discharge oil separators.

The most important detail in pumping of oil is the design of the compressor itself, and for the past 10 years all of the manufacturers have been devoting considerable research to the point of highly polished cylinder liners, closely fitted pistons and piston rings, for it is the design of the piston and cylinder that is the basic cause of oil pumping. Expansion valves opened too wide, and improperly designed flooded controls, both of which might allow liquid to return to the suction line, are another serious source of oil pumping.

This is caused by liquid spilling into the crankcase and causing violent foaming or ebullition of the oil-refrigerant mixture which finds its way up into the cylinders. This, too, is the basic cause of losing oil pressure, and in the installation in question suitable safety devices have been installed to shut down the compressor in case of oil pressure failure.

The design of piping has a good deal to do with the problem of whether one compressor or another returns liquid slugs to the crankcase. It is advisable to take the suction connection to the compressor from the top of the header.

Another source of liquid in the crankcase is caused by the crankcase being at a lower temperature than the evaporator or receiver during shutdown periods, and a natural refrigeration effect takes place evaporating from either the receiver or cooler and condensing in the cold crankcase. A valve arrangement or suitable traps in the piping can be designed to prevent this condition, which is very often evident where evaporative condensers are used.

The oil drain line from the cooler into the suction of the header is also very advisable and desirable to drain continually an oil solution from the cooler, preventing overconcentration.—B. W.

What's Experience with Ceiling Panels in Severe Weather?

YOU ARE INVITED *to answer the following question which has been asked by a reader of HPAC. Suitable comment on the matter will be welcomed and space permitting will be published. Sketches or photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

"The question has arisen in this office several times as to the advisability of ceiling type radiant panels for buildings in this section of the country without providing a floor panel, where these buildings are situated on a compacted sand fill using a 4 in. concrete slab as the floor.

"From the heat loss calculation standpoint, under certain conditions sufficient panels can be provided in the ceilings without going to auxiliary panels in the walls or floor.

"However, the question comes to mind that trouble may develop along the outside walls of installations of this nature where conditions would be such in extreme weather that moisture and frosting would occur under extreme conditions of minus 30 deg even though a strip of 1 in. rigid insulation were provided between the footings and the floor around the outside perimeter of the building.

"We are writing with the thought that perhaps those who have had some experience with this type of installation might have comments and recommendations, which would be most welcome."

R. P. (Montana).

Heating, Piping & Air Conditioning

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

JOURNAL *SECTION*

Effect of Temperature on Balance of Forced Warm-Air Systems†

By N. A. Buckley*, S. Konzo**, J. M. David‡, and T. L. Towne††, Urbana, Ill.

SUMMARY — Unbalance in a forced warm-air system was studied by testing in the laboratory and by an analytical method. When unheated air was circulated in a system, a change in total air quantity resulted in a proportionate change in delivery of each branch. A system which was in balance with large total quantities of heated air tended to become unbalanced when the total quantity became relatively small. The unbalancing action was attributed to stack effect. Close agreement was obtained between test and predicted values.

A FORCED warm-air heating system which maintains desired indoor temperatures in all occupied spaces, and under all load conditions, is considered to be in balance. Normally any unbalance which occurs in a system can be traced directly to unusual weather conditions such as high velocity winds, or intense solar radiation. However, some cases have been reported in which the unbalance that was observed could not be attributed to unusual weather conditions alone.

Up to this time no satisfactory explanation has been offered for this phenomenon although the evidence indicates that the unbalance was in some ways related to the total volume of air flowing in the system and the relative elevations of the supply registers. In some extreme cases it has been observed that a warm-air register located in the basement may become sufficiently unbalanced so that under mild weather conditions the supply of warm air is reduced to a negligible quantity. In view of the widely varying explanations as to the cause and extent of this unbalance, a series of laboratory tests under controlled conditions was conducted. This paper gives a condensed summary of the investigations and offers an explanation of the factors which affect the balance of an air distribution system. Furthermore, a method is presented for predetermining the location and magnitude of unbalance for any given system.

Description of Test Apparatus

The test arrangement, shown schematically in Fig. 1, consisted of a four-stack system, in which register openings were located on three different levels above the furnace. This arrangement simulated a heating installation for a two-story residence in which a basement room is heated. The basement outlet may also be considered to be approximately of the same elevation as a floor register or baseboard register on the first floor. The trunk duct was of the extended plenum type[1], and its dimensions were 12 in. × 8 in. from the furnace plenum to the far end. The trunk size of this extended plenum corresponds to the trunk size at the furnace plenum for a system designed in accordance with Manual 7 of the *National Warm Air Heating and Air Conditioning Association*. Each of the four branch ducts consisted of a $3\frac{1}{4}$ × 12 in. stack but with registers omitted at the stack-head.

The blower installed in the furnace supplied the motive head necessary to overcome the various resistances of the system and to draw the desired volume of air through the *National Bureau of Standards* type nozzle installed at the return-air inlet of the furnace. The de-

†This investigation is a part of the cooperative project jointly sponsored by the Engineering Experiment Station of the University of Illinois and the *National Warm Air Heating and Air Conditioning Association*.

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Exponent numerals refer to References at end of Appendix.

sired flow rate of air into the system was obtained by selection of the proper sized nozzle, and by the adjustment of a slide damper installed between the furnace and the nozzle chamber. Egg-crate straighteners were inserted in the trunk duct for the purpose of eliminating swirling motion from air entering the trunk duct or test section.

The volume flow rates out of each of the individual branches were obtained by means of a vane anemometer installed in each branch and separately calibrated in place against the *National Bureau of Standards* type nozzles. The calibration of these anemometers was established both with recirculated laboratory air and heated air.

The temperature of the air flowing through the system was measured by means of thermocouples placed in the nozzle chamber, in the trunk duct near the furnace plenum, at each branch take-off and at each stack head. Temperatures at any six stations could be recorded continuously by means of a recording potentiometer. Periodic measurements of temperatures at all thermocouple stations were made during actual test runs with a precision type potentiometer.

For a second test arrangement, which simulated a system having register openings on only two elevations, branch duct No. 1 to the basement was closed and sealed. The instrumentation for the tests on this three-branch system was the same as that for the four-branch system.

Method and Procedure for Conducting Tests

Tests were conducted on both the three- and four-branch systems with zero heat input, as well as with heat inputs of 5000 Btu per hr, 15,000 Btu per hr, 25,000 Btu per hr, and 35,000 Btu per hr. With zero heat input to the system, the total air volume was varied over a range from about 100 cfm to 500 cfm. For each adjustment of total air volume, the flow through each branch duct was recorded and plotted as shown in Fig. 2. Similar tests were conducted for each of the four heat inputs to the furnace, and temperature measurements were made at all thermocouple stations.

Results of Tests with Zero Heat Input

For zero heat input to the system, the values for branch air volumes were plotted as shown in Fig. 2, against the total air volumes. A straight line could be drawn through the points representing the data for each of the branches.

Since no density changes were involved from the inlet to the registers, the total air volume passing through the nozzle should be equal to the summation of the air volumes flowing through the stacks. An agreement within about 3 percent was obtained which was considered to be within the range of experimental error.

From the data shown in Fig. 2 it would appear that the frictional resistances, and therefore the equivalent duct lengths, of branches Nos. 1 and 2 were greater than those for branches Nos. 3 and 4. Calculated values of the equivalent duct lengths made from the best available data were: 144, 98, 73, and 67 ft respectively for branches Nos. 1, 2, 3, and 4. These calculated values of equivalent length, therefore, substan-

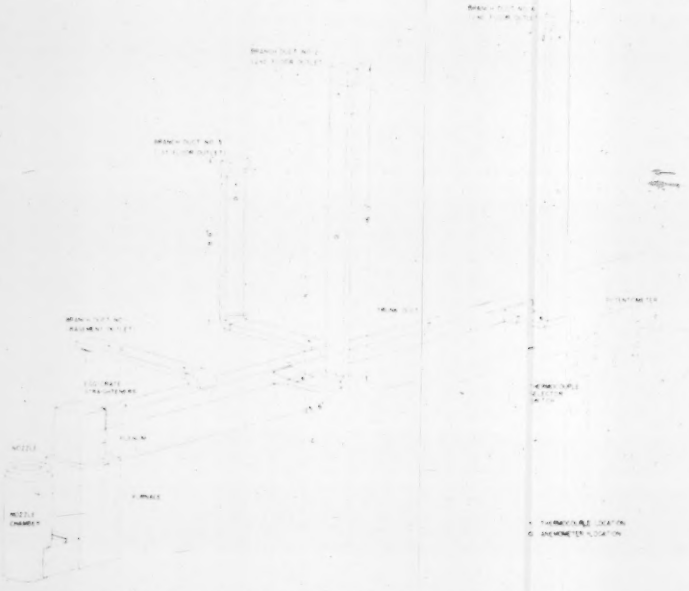

Fig. 1—Laboratory test arrangement for study of air distribution

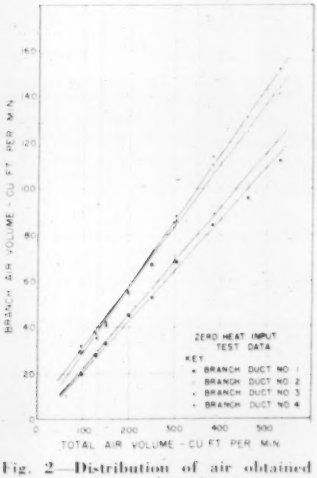

Fig. 2—Distribution of air obtained with zero heat input

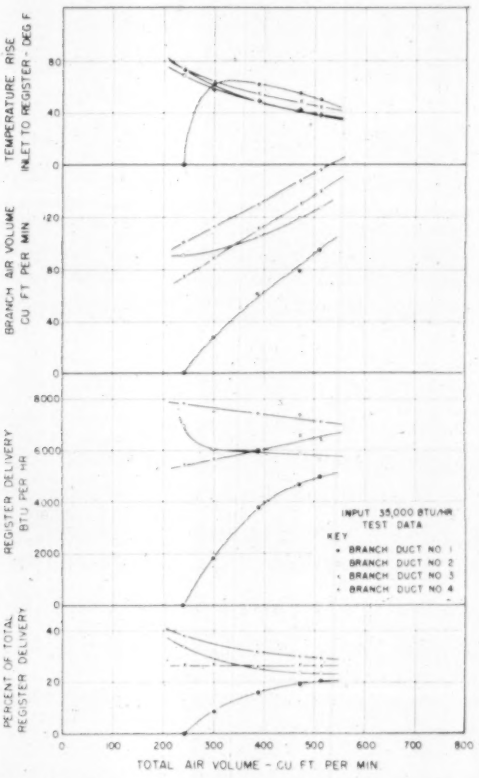
TEMPERATURE RISE INLET TO REGISTER - DEG F
BRANCH AIR VOLUME CU FT PER MIN
REGISTER DELIVERY BTU PER HR
PERCENT OF TOTAL REGISTER DELIVERY
INPUT 35,000 BTU/HR TEST DATA
KEY
BRANCH DUCT NO. 1
BRANCH DUCT NO. 2
BRANCH DUCT NO. 3
BRANCH DUCT NO. 4
TOTAL AIR VOLUME - CU FT PER MIN

Fig. 3—Test results obtained with 35,000 Btu per hr

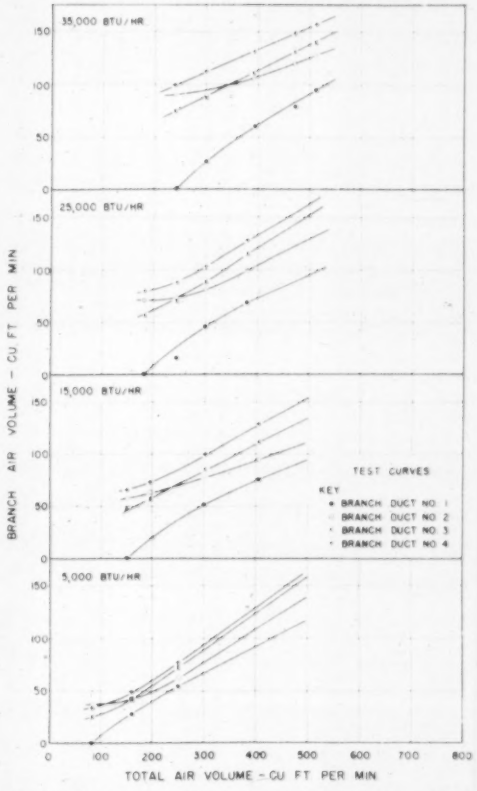

Fig. 4—Distribution of air obtained with the four-stack system

tiated the results obtained from the test data.

For all practical purposes, the four curves shown in Fig. 2 converge toward the origin. The slight discrepancy of the data for branch No. 3 in this respect has been attributed to the uncertainties in measuring the low air volumes. In the case of zero heat input the evidence indicates that as the total air volume was changed, the flow through each of the branch outlets was proportionally changed. Hence, it may be concluded that no unbalancing action occurred in this four-stack arrangement. Similar results were obtained with the three-stack arrangement and with zero heat input.

Results of Tests with Heat Input

When heat was added to the duct system, proportional air delivery to each of the four branches was no longer obtained. For low total volumes, flow through one of the branch ducts decreased to zero with a resulting increase in flow in the three remaining branches. This is illustrated by the second group of curves from the top of Fig. 3 which shows complete data for an actual test in which the heat input was 35,000 Btu per hr. For example, branch duct No. 1 delivered 92 cfm, or 18.4 percent when the total volume was 500 cfm, and zero cfm when the total volume was about 240 cfm. It was also observed that for total volume less than 240 cfm, the direction of flow in branch duct No. 1 was reversed and cool laboratory air was introduced into the trunk duct. As may be noted from Fig. 1 branch duct No. 1 led to a basement outlet and was at the same elevation as the trunk duct. In all cases the observed air volumes for the branch ducts were corrected to laboratory conditions of temperature and pressure, before plotting.

Air volume alone is not a criterion of heat delivery to a given space, since air temperature is also involved. For the purpose of determining the register delivery, air temperature measurements were made, and the values of temperature rise were plotted as shown in the top group of curves in Fig. 3. Since the tests were made with a constant heat input, any decrease in total air volume should result in an increase in temperature rise. This was observed to be the case for total air volumes greater than about 325 cfm. For total volumes less than 325 cfm the temperature rise for branch duct No. 1 decreased sharp-

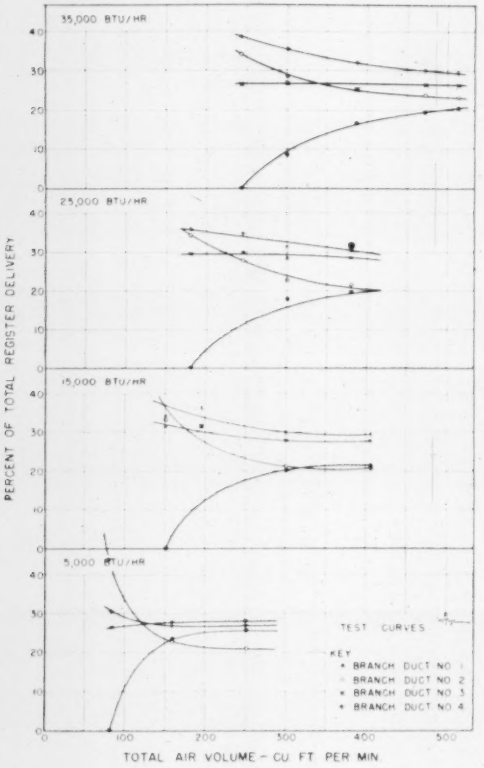

Fig. 5—Percent of total register delivery for the four-stack system

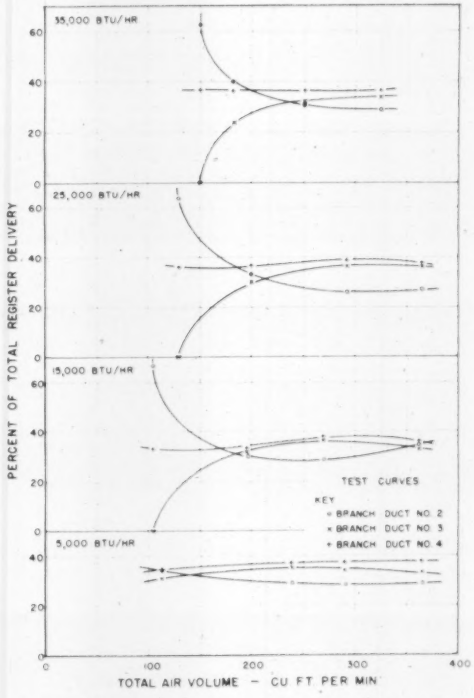

Fig. 6—Percent of total register delivery for the three-stack system

ly as the result of excessive heat loss of the duct accompanying the low velocities in the duct.

The third group of curves from the top of Fig. 3 represent the register deliveries which were defined as:

$$H = 60 \cdot C_p \cdot Q \cdot \rho \cdot \Delta t,$$

where,

H = Register delivery, Btu per hour.
C_p = Specific heat of air, Btu per (pound) (Fahrenheit degree).
Q = Branch volume flow rate, cfm.
ρ = Air density, pounds per cubic foot.
Δt = temperature rise inlet to register, Fahrenheit degrees.

From the standpoint of distribution balance, the percent of total register delivery is of more significance than the actual magnitudes of register delivery. These percentages were plotted as shown in the bottom set of curves in Fig. 3. A constant percentage over a wide range of total volumes, as shown for branch duct No. 3, indicates that no unbalancing action occurred in this particular branch. The unbalancing action is clearly shown for branches Nos. 1, 2, and 4. In the case of branch No. 1, the register delivery decreased to zero as the total volume was decreased, whereas for branch ducts Nos. 2 and 4 the converse was true. The data shown in Fig. 3 apply only to a fixed heat input of 35,000 Btu per hr. It was necessary, therefore, to investigate the conditions existing for heat inputs between zero and 35,000 Btu per hr, and the results of such tests are shown in Figs. 4 and 5.

Up to this point in the discussion, Fig. 2 indicated that no unbalancing action occurred with zero heat input, whereas Fig. 3 indicated considerable unbalancing action with 35,000 Btu per hr heat input. The values for branch air volumes shown in Fig. 4 for heat inputs of 5,000 Btu per hr, 15,000 Btu per hr, and 25,000 Btu per hr indicate that the unbalancing action is a function of the heat input. That is, the curves for the 5,000 Btu per hr input more nearly approximated those shown in Fig. 2 for zero heat input, while the curves for 25,000 Btu per hr approached those shown in Fig. 3 for 35,000 Btu per hr. In all cases the unbalancing action was more pronounced for low total volumes flowing. Furthermore, branch duct No. 1 was always the branch which reached zero air delivery or the drop-out point.

Curves showing the percent of total register delivery for the four heat inputs are given in Fig. 5 and confirm the evidence shown in Fig. 4. Branch duct No. 3 shows relatively constant percentage of delivery over a wide range of total air volumes and heat inputs. Branch ducts Nos. 2 and 4 which were second story stacks showed a tendency to deliver a higher percentage of total register delivery with lower total air volumes. On the other hand, branch duct No. 1, which served as a basement outlet, reached a drop-out point.

Curves similar to those shown in Fig. 5 were obtained for the three-stack arrangement consisting of branch ducts Nos. 2, 3, and 4, and are given in Fig. 6. In this case where the basement outlet was not involved, the stack which reached the drop-out point was branch No. 3 which served a first story register. In this case branch duct No. 4 showed a relatively constant percentage of total register delivery, and stack No. 2 showed an increasing percentage with lower total air volumes. From the evidence shown in Figs. 5 and 6, it may be noted that the registers at the lowest elevation in a given duct system reached a drop-out point.

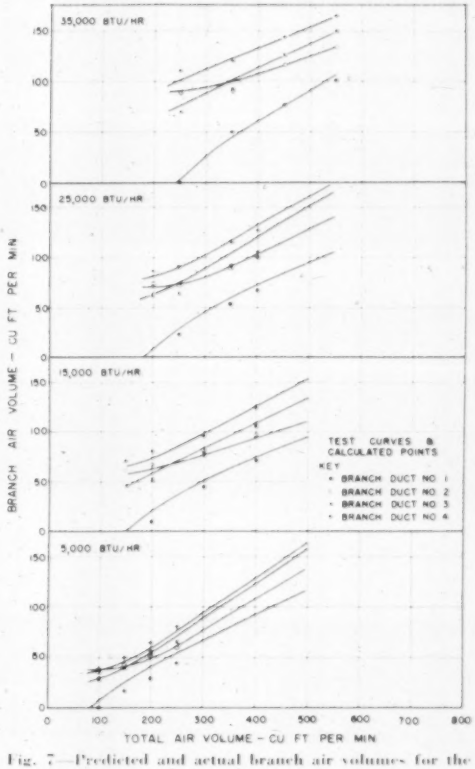

Fig. 7—Predicted and actual branch air volumes for the four-stack system

Factors Which Cause Unbalance

Any explanation of the unbalancing action must account for the phenomena shown in Figs. 5 and 6. It should be noted that no change was made in the duct system and that no appreciable changes in external temperature or pressure were observed. The only difference consisted of changes in the properties of the fluid flowing. In the case of the data shown in Figs. 2 and 3, the changes in density of the air were due to the addition of heat. This would lead to the conclusion that the unbalancing action was related to stack effect.

For the gravity warm-air heating system, the expansion of warm air and the consequent reduction in density, furnishes the motive head necessary to cause air circulation. In a forced-air system a similar motive head is present. This motive head, or stack effect, influences the circulation through the system to a greater or lesser degree depending upon the temperature of the flowing air and the pressures created by the furnace blower. In other words, the *total* motive head acting to produce flow of air through a given branch duct is composed of a stack effect and a pressure head produced by the furnace blower. Where differences in register elevations exist, the stack effects in the various branches are not the same since both air temperatures and stack heights are involved.

If the total motive head in some of the stacks of a forced-air system were disproportionately great, due to presence of stack effect, these stacks would tend to take more than their share of the total air volume handled, thus robbing the stacks having less total motive head. For the test arrangement shown in Fig. 1, branch ducts Nos. 2 and 4 have stack heights of 16 ft above the trunk duct, whereas branch duct No. 1 has zero stack height. It would be expected that branch ducts Nos. 2 and 4 would tend to rob branch duct No. 1, if the stack effect is of sizable magnitude relative to the pressure effect of the furnace blower. The greatest unbalance would be obtained when the temperature of the air flowing was high (large stack effect) and the total air volume was low (small effect of blower pressure). It is conceivable that the total motive head of the lowest stack could be zero when the stack effect of the higher stacks equals the blower pressure available at the take-off of the lower stack. For

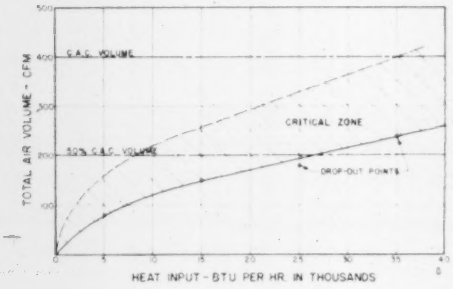

Fig. 8—Application of test results to single- and two-speed blowers

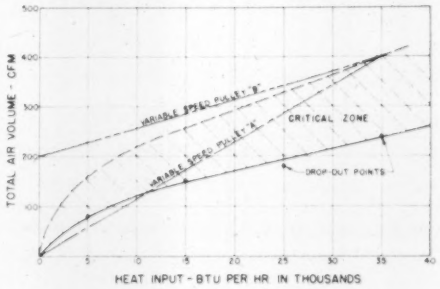
TOTAL AIR VOLUME - CFM
HEAT INPUT - BTU PER HR IN THOUSANDS
VARIABLE SPEED POINT "B"
VARIABLE SPEED POINT "A"
CRITICAL ZONE
DROP-OUT POINTS

Fig. 9—Application of test results to variable speed blowers

these conditions the flow in the lower stack would become zero. This explanation is therefore offered for the unbalancing observed in Figs. 5 and 6.

Results of Predicted Unbalance

If the foregoing explanation is adequate it should be possible to make a prediction about when and to what extent unbalance will occur. For example, in a given system with a known quantity of air flowing and a known heat input, it should be possible to calculate the system resistance to flow, and the stack effect. Such predictions were made, as discussed in detail in the following Appendix, and the results are shown as plotted points in Fig. 7. The solid curves shown in the same figure represent actual test data, and are the same as those shown in Fig. 5. Excellent agreement was obtained between the predicted and actual test data. Thus the explanation which has been presented adequately accounts for the unbalancing action shown in Figs. 5 and 6.

Application of Results

Specifically the preceding discussion applies only to the extended plenum duct system shown in Fig. 1. However, since the actual test results and the predicted results were in excellent agreement, it would appear that this method of prediction could be applied to duct systems other than those tested in the laboratory.

Previously it was noted that the unbalancing action was a function of the heat input and was more pronounced for low total volume flowing, and that in the four-stack system, branch duct No. 1 was always the branch which reached the *drop-out point*. Values of total air volume at the *drop-out point* for various heat inputs were obtained from Figs. 4 and 5 and were plotted against the corresponding heat input as is shown in Fig. 8. The solid line curve drawn through the points represents the total air volume for which branch duct No. 1 gives zero air delivery for a range of heat inputs. A second curve was established in Fig. 8 for that value of the total air volume at which unbalance became readily apparent. For example, from Fig. 5 for a heat input of 15,000 Btu per hr the deviation of the curves from the horizontal line, representing a constant percentage of total register delivery, became apparent at approximately 260 cfm. This volume together with similar values for other heat inputs is represented by the broken-line curve in Fig. 8 and has been designated as the *break-away* curve. The area between the curves for *drop-out* and *break-away* is indicated as the *critical zone*. Any method of control or operation which will allow the heating system to operate in this *critical zone* will result in unbalanced heat distribution.

The question arises as to how a heating system with a single rate of input can operate at any other input. The methods of control which are commonly employed produce widely varying heat inputs by intermittent operation of the burner. For example, a gas furnace with an input rating of 40,000 Btu per hr could be operated with a three minute *on* cycle and a nine minute *off* cycle during mild weather. In this case the average input will be approximately 10,000 Btu per hr.

If the total air volume were adjusted to provide a 100 deg temperature rise from inlet to bonnet, in accordance with the *continuous air circulation* principle[4], a total air volume of approximately 400 cfm would be circulated when a rated heat input of 40,000 Btu per hr was maintained. Then, during extremely severe weather when the furnace was operating continuously, at maximum capacity, the system would operate within the fringe of the critical zone as is indicated in Fig. 8.

For all weather conditions in which less than 35,000 Btu per hr was required, which would be the case for practically the entire season, the system would operate above the critical zone and no unbalancing would be experienced. Critical unbalancing should not be experienced for a duct system whose air volume is in conformity with the *continuous air circulation* principle.

Normally, a system which is adjusted to deliver a given air quantity can be expected to maintain this delivery indefinitely. However, if any change in system resistance occurs so that a much smaller volume is being circulated then the possibilities increase of obtaining an unbalanced distribution. For ex-

ample, if the air filter resistance increases over a long period of time, the total air volume will decrease. A point will eventually be reached when the total air volume will be only a fractional part of the initial air volume. For the case shown in Fig. 8 in which the system was balanced for an initial total air volume of 400 cfm, some difficulties in distribution balance can be expected when the total air volume decreases to a value of about 300 cfm or less. A similar analysis applied to the case of a two-speed blower indicates that for certain methods of operation an unbalance can be expected. For example, if the blower were adjusted so that the total air volume flowing was 200 cfm for the low speed operation in mild weather and 400 cfm for high speed operation in severe weather, then some difficulty can be expected in balancing at the low speed during mild weather. In this example during low speed operation the system would operate in the critical zone for weather conditions requiring more than about 8000 Btu per hr input. When the weather became severe and the blower operated at the higher speed the system would again operate above the critical zone. On the other hand, if the blower were adjusted so that 300 cfm was delivered at low speed and that 500 cfm was delivered at high speed, unbalance should not be experienced if the change to high speed operation was made at an input of 25,000 Btu per hr or less.

In a similar manner the operating conditions for variable speed blowers may be analyzed as illustrated in Fig. 9. The curve designated as *variable speed pulley A* illustrates one type of operation in which the speed of the blower is low for low heat inputs and increases proportionately with heat input. Maximum speed is reached when maximum heat input is obtained during severe weather conditions. For this method of operation the curve representing the volume delivery of the blower falls below the drop-out curve for heat inputs less than about 11,000 Btu per hr; and falls within the critical zone for heat inputs between 11,000 and 35,000 Btu per hr. Therefore, for this method of operation, unbalance in distribution of air quantities should occur over a wide range of weather conditions.

The curve designated as *variable speed pulley B* illustrates a more successful type of operation of a variable-speed blower in which the blower starts operating at 50 percent of full speed and increases gradually in speed with increasing heat inputs. For this method of operation the curve representing the volume delivery of the blower lies above the critical zone over the entire range of heat inputs. In this case no unbalancing action is to be expected.

It should be emphasized that the preceding discussion relative to Figs. 8 and 9 was based upon results obtained from a test arrangement in which the registers were located at three elevations. In the three-branch system which had registers at only two elevations, the unbalancing action was found to be less severe. Since the unbalancing action has been shown to be due to the differences in stack heights of the various branches, no unbalance should be expected in a system having all registers at the same elevation.

Conclusions and Summary

For the conditions described in this paper the following conclusions could be drawn:

1. With zero heat input, any change in the total air volume delivery was accompanied by a proportional change in the flow through each of the branch outlets.

2. When heat was added to the duct system, proportional air delivery to each of the branches was no longer obtained. For the arrangement tested branch ducts Nos. 2 and 4 to second story registers showed a tendency to deliver a higher percentage of the total volume delivery and particularly with low values of the total volume delivery. On the other hand branch duct No. 1 which served a basement outlet reached a drop-out point or zero air delivery.

3. A comparison of tests in which no change was made in the duct system, and no appreciable change was observed in pressures and temperatures external to the duct system, indicated that the addition of heat to a duct system in which registers are located at more than one elevation results in an unbalancing action. This action was attributed to differences in stack height.

4. An analytical method was devised for predicting the air distribution in an extended plenum duct system with heat added to the system. In this analysis, the stack effect was superimposed upon the pressure supplied by the furnace blower. Good agreement was obtained between predicted and actual results, thus confirming the validity of the stack effect as a possible cause of unbalanced distribution.

5. The application and extension of the test results obtained from the four-branch arrangement to the following cases were discussed in detail: *(a)* single-speed blower, *(b)* effect of filter resistance, *(c)* two-speed blowers, and *(d)* variable speed blowers. On the basis of this analysis it would appear that the unbalancing action could be avoided by proper adjustment of volume flow rates to heat input.

6. In the three-branch system which had registers at only two elevations the unbalancing action was found to be less severe than that in the four-branch system. Furthermore, no unbalance should be expected in a system having all registers at the same elevation.

Acknowledgment

This paper is a report of a laboratory investigation conducted under the terms of the cooperative agreement between the University of Illinois Engineering Experiment Station and the *National Warm Air Heating and Air Conditioning Association*. Acknowledgment is made to the Research Advisory Committee of the Association for advice and counsel received.

Acknowledgment is also made to F. S. Alexander, former graduate student at the University of Illinois, for service rendered in construction of the test arrangement and conducting of initial tests.

APPENDIX

Method for Predicting Air Distribution in a Duct System

An analytical method was used to predict the air distribution in the extended plenum duct system tested in the laboratory. The step by step pro-

Table 1—Values Obtained from Sample Calculations for Determining Air Distribution

(Heat Input — Heat Output — 25000 Btu per hr)

1. Branch duct No.	1	2	3	4
2. Equivalent length of branches, ft	114	98	73	67
3. Total pressure at the branch take-off, in. of water	0.035	0.035	0.035	0.035
4. Pressure available per 100 ft of branch duct, in. of water	0.031	0.036	0.048	0.053
5. Air volume flowing, zero heat input, cfm	75	82	96	101
6. Temperature difference inlet to register, deg	49	36	41	40
7. Density of air in the stack, lb per cu ft	0.0668	0.0684	0.0678	0.0679
8. Air volume flowing, corrected for density, cfm	81.7	87.4	103	108
9. Loss per 100 ft. of branch duct, from chart, in. of water	0.036	0.041	0.055	0.061
10. Loss per 100 ft of branch duct, corrected for density, in. of water	0.033	0.038	0.051	0.069
11. Pressure to deliver corrected volume, in. of water	0.037	0.037	0.037	0.037
12. Stack effect, in. of water	0	0.014	0.008	0.016
13. Combined stack pressure, in. of water	0.024	0.052	0.040	0.056
14. Stack pressure per 100 ft of branch, in. of water	0.021	0.053	0.055	0.084
15. Stack pressure per 100 ft of branch, corrected for density, in. of water	0.023	0.056	0.059	0.090
16. Volume of heated air flowing, cfm	61	104	107	135
17. Volume corrected to inlet air temperature, cfm	59	98	100	126
18. Percent of total volume	15.4	25.6	26.1	32.0
19. Branch air volumes for total volume of 350 cfm	53.8	89.6	91.4	115.2

cedure will be outlined with explanatory paragraphs to clarify each step. As a further illustration of the method, sample calculations were made for the laboratory arrangement and the values are tabulated in Table 1. For the purposes of this analysis a number of assumptions were made and are explained in detail under the appropriate items.

The heat input to the furnace can be determined for a given furnace from the measured rate of fuel input and the heating value of the fuel. The bonnet capacity or heat output is then the product of the heat input and the bonnet efficiency. For the electric furnace used in the laboratory test arrangement, a bonnet efficiency of 100 percent was assumed. A heat input and output of 25,000 Btu per hr was used for the example shown in Table 1.

Explanation

In the following explanation, the paragraph numbers correspond to items in Table 1.

1. *Branch duct number.* Branch duct numbers are shown in Fig. 1.

2. *Equivalent Length of Branches, feet.* The equivalent lengths of the branch ducts were the sum of the actual lengths of the branch ducts, plus the equivalent lengths of the fittings.

3. *Pressure available at the branch take-off, inches of water.* In normal design procedure for a forced-air system, the maximum available pressure at the discharge of the furnace is assumed to be 0.10 in. of water; this would apply only to the maximum volume delivery. For the purpose of covering a wider range of air volumes it would be possible in the analytical procedure to select a number of values of available pressure within the range from 0 to 0.10 in. of water. Actually, the calculations were based upon four assumed pressures of 0.012, 0.018, 0.035, and 0.045 in. of water. In the example shown in Table 1, calculations are given only for one of these assumed pressures, namely 0.035 in. of water. For the arrangement shown in Fig. 1 calculations indicated that the frictional losses in the trunk were negligibly small. Hence, the pressures available at all branch take-offs were considered to be equal.

4. *Pressure available per 100 ft of branch duct, inches of water.* For an assumed pressure in the trunk duct and for known equivalent length of branch duct the friction loss per 100 ft of branch duct can be determined by the following equation:

$$\text{(Item 4)} = \frac{\text{(Item 3)} \times 100}{\text{(Item 2)}}$$

5. *Air quantity flowing, zero heat input, cubic feet per minute.* The 3¼ in. × 12 in. branch ducts shown in Fig. 1 were considered to be equivalent to a 6.6 in. round pipe. The volume of air flowing through the duct could then be determined from the friction chart.

6. *Temperature difference inlet to register, Fahrenheit degrees.* For the known heat input of 25,000 Btu per hr and total air volume flowing (Item 5), the temperature rise from inlet to bonnet of the furnace could be determined. The temperature drops of the air from the bonnet to the registers could be calculated from curves shown in a previous paper[1]. The values for Item 6 could then be obtained by subtracting these values from the temperature inlet to bonnet. However, since it was desired to make comparisons with the actual test data shown in Fig. 4, actual temperature rises from test data were entered in Item 6.

7. *Density of air in the stack, pounds per cubic foot.* The densities of the air at each register were determined from the temperatures listed in Item 6 and an assumed barometric pressure of 29.10 in. of Hg.

8. *Air volume flowing corrected for density, cfm.* Assuming that a constant mass flow rate is maintained, the volume flow rate corresponding to the density of Item 7 was calculated as follows:

$$\text{(Item 8)} = \text{(Item 5)} \times \frac{\text{(density of air entering furnace)}}{\text{(Item 7)}}$$

9. *Loss per 100 ft of branch duct, from friction chart, inches of water.* This is obtained from the friction chart for the 6.6 in. equivalent diameter and the air quantities listed in Item 8. The friction chart is based on standard air of 0.075 lb per cu ft density.

10. *Loss per 100 ft of branch duct, corrected for density, inches of water.* As stated in THE GUIDE, "For ordinary ventilating work, friction may be assumed to vary directly as the density without serious error." In the example

$$\text{(Item 10)} = \text{(Item 9)} \times \frac{\text{(Item 7)}}{\text{(Standard density)}}$$

11. *Pressure to deliver corrected volume, inches of water.* This pressure is for the equivalent length of duct.

$$\text{(Item 11)} = \frac{\text{(Item 10)} \times \text{(Item 2)}}{100}$$

12. *Stack effect, inches of water.* The stack effect may be determined from the following equation:

$$\text{(Item 12)} = 7.50\, L \left(\frac{1}{533} - \frac{1}{T} \right)$$

where

L. = height of stack above plenum, feet.

T. = temperature of the air in the stack, Fahrenheit, absolute.

In the following section this stack effect has been considered to be the same as the effect produced by an exhauster fan mounted on the register of each branch.

13. *Combined stack pressure, inches of water.* The detailed procedure for determining the combined stack pressure is illustrated in Table 2. The tabulated stack effects (b, c, d, and e), shown in Section A of Table 2 were obtained from Item 12 of Table 1.

The first step shown in Section B of Table 2 was to treat the system as if the stack effect alone were acting. It was assumed that the stack effect was analogous to the effect of a fan mounted at the outlet of each of the stacks and exhausting from the plenum. The capacity of the fan would increase in proportion to the effective height of the stack and the temperature of the air.

Therefore, the stack effects of branch ducts Nos. 2 and 3 would be equivalent to fans of equal capacity since they were of the same height, the stack effect of branch duct No. 3 would be equivalent to a smaller fan and the stack effect of branch duct No. 1 would be zero and would have no fan since it was a basement outlet with no effective stack height.

Since the fans which were assumed to be acting at the outlets of branch ducts Nos. 2, 3, and 4, would be acting in parallel, the following excerpt from a section on Fans in Parallel, page 284 of Reference 7 was used as a criterion:

"As in the case of fans in series, the electric circuit analogy may be used also for fans in parallel. When two or more identical low-pressure fans are placed in parallel the characteristic curve of the combined set is such that the capacity is the sum of the separate capacities for a given static or total pressure.

"If the two fans are of different types or of different speeds, or both, ... Constant static pressure is used in this case upon which to combine capacity. The total pressure of the fan is based upon total capacity and total outlet area. In most cases this will be the average of the separate total pressures. If the fans lead into a common

Table 2—Detailed Procedure for Calculating Item 13 of Table 1

Branch Duct No.	1	2	3	4
A. Stack Effects (Assuming no Blower Operation)				
Stack Pressure, combined	(1)	(m)	(n)	(o)
Stack Effect	= 0 (b)	0.011 (c)	0.008 (d)	0.016 (e)
Blower Pressure	(a)			
Averaged Stack Effect		(h)	(g)	(f)
Trunk Pressure		(i)	(j)	(k)
B. Average Stack Effects in Trunk Duct (Assuming no Blower Operation)				
Stack Pressure, combined	(1)	(m)	(n)	(o)
Stack Effect	= 0 (b)	0.011 (c)	0.008 (d)	0.016 (e)
Blower Pressure	(a)			
Averaged Stack Effect		0.013 (h)	0.012 (g)	0.016 (f)
Trunk Pressure		(i)	(j)	(k)

Branch Duct No.	1	2	3	4
C. Combined Stack Pressure for Stack No. 1				
Stack Pressure, combined	0.021 (1)	(m)	(n)	(o)
Stack Effect	= 0 (b)	0.011 (c)	0.008 (d)	0.016 (e)
Blower Pressure	0.037 (a)			
Averaged Stack Effect		0.013 (h)	0.012 (g)	0.016 (f)
Trunk Pressure		0.050 (i)	(j)	(k)
D. Combined Stack Pressures for Stacks Nos. 2, 3, and 4				
Stack Pressure, combined	0.021 (1)	0.052 (m)	0.030 (n)	0.056 (o)
Stack Effect	= 0 (b)	0.011 (c)	0.008 (d)	0.016 (e)
Blower Pressure	0.037 (a)			
Averaged Stack Effect		0.013 (h)	0.012 (g)	0.016 (f)
Trunk Pressure		0.050 (i)	0.018 (j)	0.056 (k)

Note: Blower Pressure (a) is from Item 11 of Table 1. Stack Effect (b), (c), (d), and (e) is from Item 12 of Table 1.

duct with different velocity pressures and in such a manner that they will mutually influence each other the static (pressure) at the outlet of one fan will drop and the other fan rise but with little change in total air quantity. Obviously, near the shut-off condition if one fan develops greater pressure than the other, the pressure curve in this region will be a compromise with air being forced back through the fan of lower pressure and the fan of higher pressure never attaining its maximum condition for this reason."

Using the foregoing analysis the pressure in the plenum resulting from stack effect could be calculated if the branch duct temperatures were known. In the field these temperatures must be predicted if the method is to be of any value, but for the purpose of this analysis the known stack temperatures from test data were used.

Based upon the preceding discussion and the assumption that stack effect acted as a fan, the following procedure was developed for predicting the unbalance of air distribution to the branch outlets under heated flow conditions. Starting with the last take-off, it was assumed that the suction in the trunk section between take-off 3 and take-off 4 was due to suction in branch duct No. 4 only, that is, suction (e) Table 2 is equal to suction (f). The suction between take-off 2 and take-off 3 was the average of the suction at take-off 3 and the suction in the trunk section between 3 and 4, in other words,

$$(g) = \frac{(d) + (f)}{2}$$

In like manner

$$(h) = \frac{(g) + (c)}{2}$$

Items (f), (g), and (h) have been designated as *averaged stack effect*.

In Section C of Table 2 the blower pressure (Item 11) from Table 1 entered at (a) was superimposed upon these average stack effects. At take-off No. 1 in the trunk duct the blower pressure of 0.037 in. was acting upstream from the take-off, and was tending to push the air out of branch duct No. 1. The averaged stack effect (h) of 0.013 in. was opposed to the branch duct stack effect (c) of 0 in., and was tending to pull the air back into the trunk duct. The resulting total motive head in branch duct No. 1 has been designated as the combined stack pressure (1) and amounted to 0.037 − 0.013 + 0, or 0.024 in. By a similar analysis the downstream trunk pressure (i) is 0.037 − 0.013 − 0, or 0.050 in.

The values shown in Section D of Table 2 are the combined stack pressures for branch ducts 2, 3 and 4, and were obtained in the same manner. The values designated as (l), (m), (n), and (o) were then inserted in Item 13 in Table 1.

11. *Stack pressure per 100 ft of branch, inches of water.*

$$\frac{(\text{Item 14}) \times (\text{Item 9})}{(\text{Item 2})} \times \frac{100}{(\text{Item 2})}$$

15. *Stack pressure per 100 ft of branch, corrected for density, inches of water.* This correction is necessary in order to utilize the friction-chart as explained for Item 10.

$$(\text{Item 15}) \times \frac{(\text{Item 14})}{(\text{Item 7})} \times \frac{(\text{standard density})}{(\text{Item 7})}$$

16. *Volume of heated air flowing, cubic feet per minute.* This was obtained from the friction-chart for the 6.6 in. diameter duct and the pressures of (Item 15).

17. *Volume corrected to inlet air temperature, cubic feet per minute.*

$$(\text{Item 17}) = (\text{Item 16}) \times \frac{(\text{Item 7})}{(\text{standard density})}$$

18. *Percent of total volume.* The total of the branch volumes listed in (Item 17) was 382 cfm.

19. *Branch air volumes for a total volume of 350 cfm.* Since the temperature rises entered in (Item 6) were based on a total air volume flowing of 350 cfm it was necessary to reduce proportionately the volumes given in (Item 17). That is, (Item 19) = (Item 17) $\times \frac{(\text{Item 18})}{(100)}$. The values listed in (Item 19) were plotted in Fig. 7 and indicated by the points shown for 25,000 Btu per hr input and 350 cfm.

The entire procedure given in this appendix was repeated for all the points shown in Fig. 7.

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1. Fitting Losses for Extended-Plenum Forced Air Systems, by H. H. Korst, N. A. Buckley, S. Konzo, and R. W. Roose (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, February 1950, p. 111).

2. Manual 7, Code and Manual for the Design of Warm Air Winter Air Conditioning Systems, 2nd Edition (*National Warm Air Heating and Air Conditioning Association*, 1947).

3. Temperature Drop in Ducts for Forced-Air Heating Systems, by A. P. Kratz, S. Konzo, and R. B. Engdahl (*University of Illinois Engineering Experiment Station Bulletin* No. 351, 1944).

4. Manual 6, Service Manual for Continuous Air Circulation Technicians, 1st Edition (*National Warm Air Heating and Air Conditioning Association*, 1947).

5. ASHVE RESEARCH REPORT No. 1280 A New Friction Chart for Round Ducts, by D. K. Wright, Jr. (ASHVE TRANSACTIONS, Vol. 51, 1945, p. 303).

6. HEATING, VENTILATING, AIR CONDITIONING GUIDE 1949 (published by THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS).

7. *Fan Engineering*, 5th Edition (Buffalo Forge Co., 1948).

John A. Goff

JOHN A. GOFF RESIGNS

John A. Goff, Philadelphia, has resigned, effective June 30, 1950, his administrative duties as Dean of the Towne Scientific School and Director of the Department of Mechanical Engineering, University of Pennsylvania. He will remain at the University for a time as professor of mechanical engineering.

Professor Goff received his B.S., M.S., and Ph.D. from the University of Illinois where he served as professor of thermodynamics until 1938, when he became Dean of Towne Scientific School and Director of Mechanical Engineering at the University.

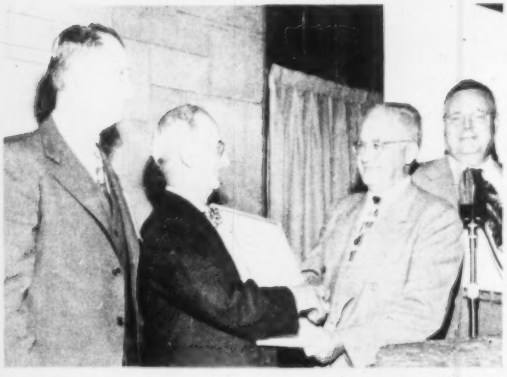
L. T. BRAUN HONORED

Louis T. Braun, for 34 years executive secretary of the *Heating, Piping and Air Conditioning Contractors' Chicago Association* and Life Member of ASHVE, was honored on his retirement with a testimonial dinner at the University Club, Chicago, Tuesday, June 27.

Speakers at the dinner, which was attended by more than 200 associates from all parts of the country, included W. M. Scott, national president, Omaha, Nebr.; J. C. Fitts, national secretary, New York, N. Y.; M. P. Durkin, general president of the United Association of Journeymen and Apprentices of the Plumbing & Pipe Fitting Industry of the United States and Canada, AFL; P. W. Lawinger, president of the *Heating, Piping and Air Conditioning Contractors' Chicago Association*, and R. D. Berry, president of the *Building Construction Employers Association of Chicago*. T. I. Magan of Los Angeles was toastmaster.

In addition to a citation and honorary membership, Mr. Braun received a grey 1950 Cadillac club coupe from the association.

Under Mr. Braun's leadership the association has been instrumental in establishing many basic codes and standards for heating, refrigeration and air conditioning. He is succeeded as executive secretary by T. M. Cunningham.



Louis T. Braun *(second from left)* receives honorary membership from Toastmaster T. I. Magan at testimonial dinner while T. M. Cunningham *(left)*, new executive secretary, and Wray M. Scott *(right)*, national president, look on

Louis T. Braun shows "motoring accessories" for 1950 Cadillac club coupe given to him by colleagues after 34 years as executive secretary of the *Heating Chicago Association*

SPEAKING CAN BE EASY—FOR ENGINEERS TOO

A practical pocket size manual, *Speaking Can Be Easy*, written by experienced engineering speakers especially for the engineer, and prepared by the Committee on Relations With Industry of the *American Society for Engineering Education*, is now available. More than three years ago a special committee started writing this concise manual to help engineers become better speakers and hold better meetings.

The special committee included: E. C. Koerper, research consultant, A. O. Smith Corp.; J. L. Singleton, vice president, Allis-Chalmers Mfg. Co.; L. J. Fletcher, director of training and community relations, Caterpillar Tractor Co.; S. D. Kirkpatrick, vice president, McGraw-Hill Book Co.; Westbrook Steele, director, Institute of Paper Chemistry; and Ward Delaney, president, Institute of Textile Technology. In addition to the work of these men and their associates, the various drafts of the manuscript have been reviewed by numerous well known speech coaches and public relations authorities.

Speaking Can Be Easy can be read through in 30 minutes. Effective organizing of the text enables the reader to cover the most important points throughout the manual in only 5 minutes. Check lists for both the speaker and the meeting chairman provide help for the improved execution of their respective responsibilities.

This manual is available at 50 cents per copy (25 percent discount in lots of 100) from the Engineers' Council for Professional Development, 29 West 39th St., New York 1, N. Y.

Transient Heat Flow Apparatus for the Determination of Thermal Conductivities

By F. C. Hooper* and F. R. Lepper**, Toronto, Ont., Canada

SUMMARY—A portable instrument consisting of an electrically heated probe has been developed and used at the University of Toronto for determining within 10 min the thermal conductivity of wet or dry solids. Specimens such as soils can be tested without disturbing their natural condition. Moisture conditions of materials do not change during test because duration is short.

Usefulness of the instrument is demonstrated and the precision of measurement indicated. The mathematical theory is developed in an Appendix.

History of Project

MARKED limitations to the usefulness of the guarded hot plate apparatus for the determination of thermal conductivity have long been apparent to workers in this field. When work on the thermal conductivity of moist soils was initiated at the University of Toronto four years ago, it soon became apparent that the hot plate apparatus would not yield results having sufficient precision.

The immediate difficulty was twofold. First, when heat flows due to temperature difference in a moist material, one mechanism of heat transmission is moisture migration with change of phase, due to vapor pressure difference in warmer and cooler positions. The hot plate is a thermal equilibrium device. It will not give a reading until the heat flow has been stabilized, a condition which does not occur until the moisture migration has ceased, at which time the specimen is no longer uniformly wetted, but is dry on the warm side and often more than saturated on the cold face. Thus, neither the moisture migration mechanism effect nor the thermal conductivity in a uniformly wetted specimen, exclusive of this mechanism, can be determined.

The second difficulty was the practical problem of obtaining structurally undisturbed soil specimens in the size and shape necessary for the hot plate. This proved exceedingly difficult.

These immediate difficulties, together with the long standing complaints that the hot plate is complicated, expensive, and certainly not portable, that it requires skill in maintenance and operation, and that it will sometimes require days to reach equilibrium and therefore gives rise to delay and high costs in testing programs, led to an investigation of alternative procedures for the determination of thermal conductivity in solids.

The most promising alternative approach appeared to be a transient heat flow procedure utilizing a line heat source. This principle had been adopted by Dr. Van der Held[1], who was visited by the first author in 1948, at the University of Utrecht in Holland. Dr. Van der Held developed this principle and applied it to an apparatus for the determination of thermal conductivity in liquids. Earlier references[2] are to be found in the literature, but formerly the theory had not been correctly developed nor properly applied.

From this starting point the object was to develop an engineering scale instrument that would be suited to the testing of building insulations, moist soils in natural location, and other wet or dry solids.

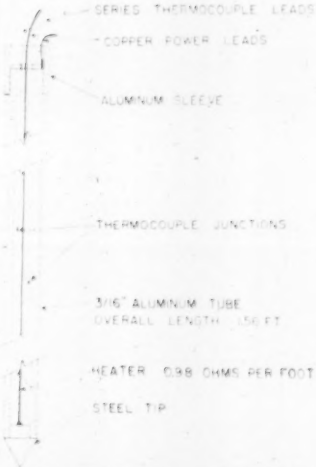


Fig. 1—Detail of thermal conductivity probe

The Instrument

The instrument, termed a thermal conductivity probe, as developed at the University of Toronto after many variations of it had been tested, is shown in Fig. 1. It consists of an aluminum tube, inside of which there is an axial constantan electrical resistance wire,

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**Research Student in Mechanical Engineering, University of Toronto.

Presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Muskoka, Ontario, Canada, June 1950.

[1]Exponent numerals refer to Bibliography

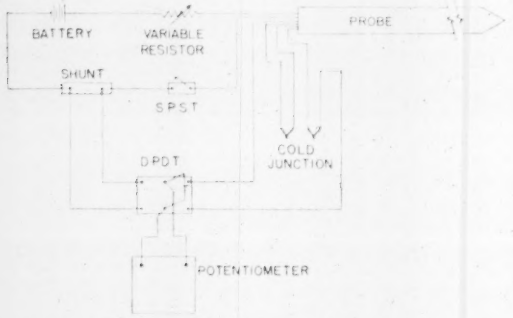

Fig. 2—Wiring and control diagram for test equipment

insulated over its length and grounded to the tube at the lower end. An electrical current can be passed through this wire to provide a heat source of constant strength. The lower end of the tube is closed by a pointed plug. The resistor leads are taken out through a seal at the upper end.

Within the tube, and near the center of its length, are located the hot junctions of several thermocouples. These junctions are connected in series with external cold junctions to give temperatures by potentiometer measurements. The thermocouple leads are also taken out through the seal at the upper end of the tube.

Fig. 2 shows diagrammatically the arrangement of the heater and thermocouples in the measuring circuit.

Principle of Operation

The instrument (probe) approximates a line heat source of constant strength in an infinite homogeneous body initially at uniform temperature. The temperature at any point in the body will be a function of several variables including time and thermal conductivity. This relationship is given by the Fourier equation:

$$\frac{\partial \theta}{\partial t} = \alpha \left(\frac{\partial^2 \theta}{\partial r^2} + \frac{1}{r} \frac{\partial \theta}{\partial r} \right) \qquad (1)$$

where

θ = temperature
t = time
α = thermal diffusivity $= \frac{k}{\rho C_p}$
k = thermal conductivity
C_p = specific heat
ρ = density
r = distance radially from heat source.

This equation can be solved for the particular case of the temperature at the source for a heat input of Q per unit length of heater as outlined in the Appendix. Thus the temperature rise $\Delta\theta$ in the interval between t_1 and t_2 is given by:

$$\Delta\theta = \frac{Q}{4\pi k} \log_e \frac{t_2}{t_1} \qquad (2)$$

where the time t_1 is selected to make terms of a lower order of magnitude in the I function* negligible (Equation 2 is developed as Equation A-14 in the Appendix).

Thus a plot of temperature against $\log_e$ (time) should show a straight portion of slope $\frac{Q}{4\pi k}$. It will be noted that the only property of the body entering this expression is the thermal conductivity, and that the other terms in Equation 2 are quantities readily measurable with the instrument described. This is the basic principle of the method.

Because the probe is of finite diameter, it is necessary to correct the foregoing result for the influence of the instrument itself. A

*See Appendix

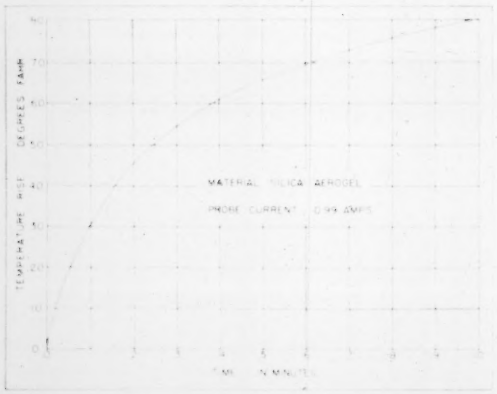

Fig. 3—Time-temperature relation in test of silica aerogel

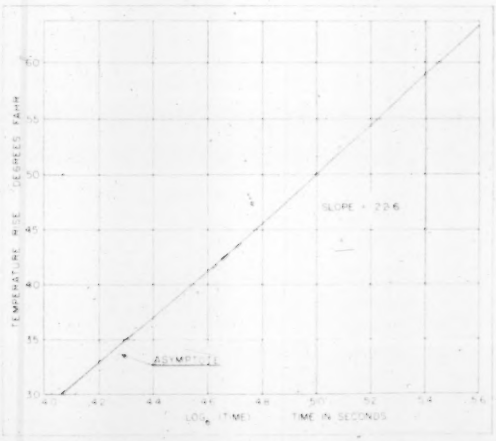

Fig. 4—Temperature rise *vs.* logarithm of time

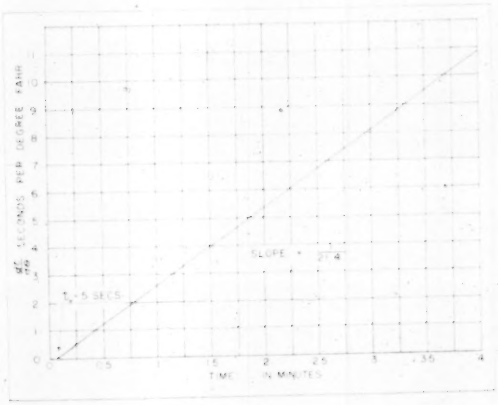

Fig. 5—Relation of $\frac{dt}{d\theta}$ to time (From data in Fig. 4)

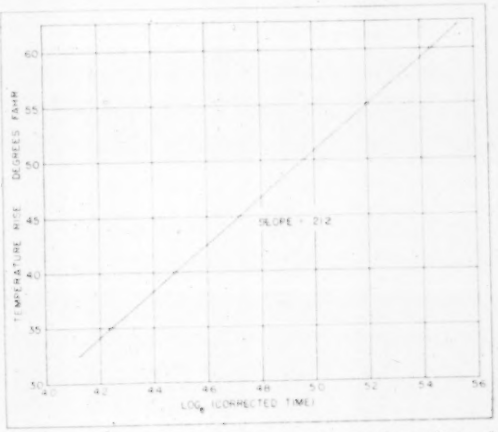

Fig. 6—Relation of temperature rise to logarithm of corrected time (From data in Fig. 4)

method, due to Van der Held, is available. This method of correction and the general theory are illustrated by the treatment of the results from an actual test made with an early model of the instrument. The material tested was silica aerogel.

Fig. 3 shows the time-temperature relation as obtained from a recording electronic potentiometer. In Fig. 4 these data are plotted against the logarithm of the time, and the theoretical relation becomes apparent. That is, the data obey the I function and after a certain time become linear.

To compensate for the finite diameter of the probe, which in effect replaces a small core of the specimen, Van der Held has shown that the difference in heat absorption between the instrument and the displaced core can be considered as a heat production before the start of measured time. That is, a time t_0 is subtracted from each observed time.

By differentiation, Equation 2 will give:

$$\frac{d\theta}{dt'} = \frac{Q}{4\pi k} \cdot \frac{1}{t'} \quad \text{(3)}$$

where

t' = corrected time. This represents a straight line of slope $\frac{1}{slope}$ = the inverse of the Equation 2 slope.

At $\frac{dt}{d\theta} = 0$, $t = t_0$, the time correction.

The data can be plotted on a corrected time scale to give the corrected slope of $\frac{Q}{4\pi k}$. Fig. 5 shows the $\frac{dt}{d\theta}$ vs. time relation taken from Fig. 4, indicating $t_0 = 5$ sec for this probe and material. Fig. 6 shows the data replotted to corrected time, giving the corrected slope 21.2. Note that the necessary condition, that the slopes of Figs. 5 and 6 be reciprocal, is nearly satisfied, slopes being 21.4 and 21.2 respectively. A closer approximation could be made if it were desired.

Thus for this test, substituting actual values

$$k = \frac{Q}{4\pi \times 21.2} = \frac{I^2 R \times 3.42}{4\pi \times 21.2} = \text{(0.0128} I^2 R \text{ Btu per hr per ft per deg F)} \quad \text{(4)}$$

where

I = current, amperes

R = resistance of heater, ohms per foot.

Because, for most materials, t_0 for a particular instrument is very nearly constant, the tedious procedure outlined can be avoided once the value of t_0 for the instrument has been determined. Moreover, if the time t_0 necessary to reduce the lower order terms of the I function to a negligible quantity is known, only two time-temperature observations need be made. The thermal conductivity is given by:

$$k = \frac{Q}{4\pi\Delta\theta_{2,1}} \log_e\left(\frac{t_2 - t_0}{t_1 - t_0}\right) = \frac{I^2 R 3.42}{4\pi\Delta\theta_{2,1}} \log_e\left(\frac{t_2 - t_0}{t_1 - t_0}\right) \quad \text{(4)}$$

The time t_0 can be calculated for any required degree of accuracy, or found from tests as in Fig. 4. For the instrument described in this paper $t_0 = 4$ min is adequate for all materials normally encountered, and by setting t_0 arbitrarily at 10 min, Equation 4 becomes

$$k = \frac{I^2 C}{\Delta\theta_{2,1}} \quad \text{(5)}$$

where

C = an instrument constant

$$= \frac{R}{4\pi} 3.42 \log_e\left(\frac{10 - 60 - t_1}{t_1 - 60 - t_1}\right)$$

$\Delta\theta_{2,1}$ = temperature rise in the interval between 4 and 10 min after start of current.

The calculation then is simply made from Equation 5.

The equivalent mean temperature of the specimen during test can be taken as the initial temperature plus $\frac{\Delta\theta}{10}$ or simply as the initial temperature.

Technique of Using the Probe

In reasonably homogeneous and flowing materials such as sand, sawdust and expanded mica, the probe need only be thrust into the specimen so that it is surrounded on both the side and the ends by at least three inches of the specimen. In hard soils or clays it is permissible to drive a steel rod of smaller diameter than the probe to make a path for the instrument.

With board materials, such as corkboard, a groove to receive the probe must be cut, or a hole be drilled to fit the instrument. Precautions must be taken to avoid air spaces if several boards are laminated to form a specimen.

For gelatins, concretes, waxes and other setting materials the probe can be cast into the specimen. Temperatures must of course be kept below the melting point of the material.

For grained materials such as wood it should be borne in mind that the heat flow measured is radial.

Any temperature gradients within the specimen prior to the start of a test must be avoided. This necessitates the allowance of a few minutes time to permit the instrument to attain temperature equilibrium with the specimen before a test can be begun. Variation in the temperature of the surroundings of the specimen may also give rise to initial temperature gradients. This can be avoided by wrapping the specimen heavily with insulation some time before a test is to be made. Larger specimens are less subject to this effect.

Time should be kept accurately, and readings of temperature and current should be carried to three significant figures.

Results are calculated directly from Equation 5.

While a wide range of currents and temperature rises can be used, in general, lower currents are suited to lower thermal conductivities.

Testing Program Results

While only a limited number of tests have so far been conducted with the final form of probe, the instrument has given very good results in tests of both wet and dry soils, sawdust, corkboard, silica gel and similar materials. Fiber insulating materials of very low density have given somewhat erratic results, possibly due to nonhomogeneity in the specimen or to convection currents arising in the interstices. Except in this material no evidence of contact effects has been found.

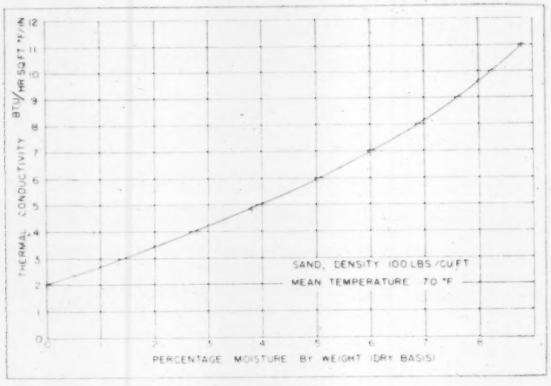
THERMAL CONDUCTIVITY BTU/HR SQ FT °F/IN
SAND, DENSITY 100 LBS/CU FT
MEAN TEMPERATURE 70 °F
PERCENTAGE MOISTURE BY WEIGHT (DRY BASIS)

Fig. 7—Typical test results for a moist material

Results have been reproducible within 0.5 percent. Absolute accuracy is much harder to estimate, but it appears to be at least equal to that of the hot plate apparatus for most materials.

The thermal conductivity probe has been very satisfactory in moist materials, particularly in soils. Examinations of the specimens following tests have indicated that no substantial alteration occurs in the moisture distribution during the short test interval. In Fig. 7 a typical set of results for a moist material is shown.

From experience in Toronto in the construction and use of several models of the instrument, several observations with respect to construction can be made:

1. As would be anticipated from the theory, a light probe of high thermal diffusivity, such as one of aluminum, should be used.

2. The thermojunctions, surprisingly enough, appear to be insensitive to radial positioning within the tube, but they must be lacquered, and of fine wire, such as B & S gage No. 33, to avoid time lag. The use of three or more thermocouples in series not only increases the precision of temperature measurement but avoids effects due to small local anomalies in the specimen. All thermojunctions should be near the center of the tube length. A spacing of about $^3/_4$ in. along the tube axis seems satisfactory.

3. The use of constantan for the resistance wire has the obvious advantage of constant current for constant voltage when temperature varies. Attempts to use a heater wire having a temperature coefficient with a view to determining temperature by the resistance variation not only lead to complicated controls to yield constant power but introduce end effect errors as well.

4. The size of the instrument can be varied widely, but a length to diameter ratio of less than 100 seems inadvisable. Large instruments require very large specimens, and small instruments are subject to slight anomalies in the specimen. For general utility, reasonable mechanical strength, and satisfactory use in coarse material, the instrument shown in Fig. 1 has been satisfactory.

5. The use of direct current avoids induction effects, permits current measurement by potentiometer, and makes it possible to use a battery and so make the instrument portable.

Present Status of Project

The initial stage in the research program was primarily directed toward the development of a satisfactory method for the determination of thermal conductivity in moist soils. The instrument developed for this purpose has been

satisfactory, and it has been successfully applied to other materials, such as building materials and insulation.

The following advantages are associated with the new method:

It will measure with equal precision the thermal conductivity of wet or of dry materials.

It will permit the testing of materials such as soils, in natural location, and consequently structurally undisturbed.

The apparatus is compact and portable. It is relatively inexpensive to construct and operate.

A determination can be made in a few minutes, and the operator requires little skill or training. The required calculations are very simple. The method is suited to production control application.

The degree of precision appears adequate for engineering use.

It should be recognized that the instrument is a primary standard apparatus. The development of the equations involved the introduction of no arbitrary constants. The instrument does not require calibration against any other standard or material.

The project is being extended at the University of Toronto in two directions: (1) more data are being accumulated both in the field and in the laboratory on the thermal conductivities of various materials, including rocks and frozen soils and (2) a smaller instrument is being developed for use in the direct determination of thermal conductivity of meats, vegetables and other foodstuffs, particularly those normally stored by cooling or freezing.

Acknowledgment

The work has been carried out in the Heat Transfer Laboratory at the University of Toronto. The authors gratefully acknowledge the financial assistance obtained from the *National Research Council* at Ottawa.

APPENDIX

The heat flow from a line source in an infinite specimen is given by the Fourier equation:

$$\frac{\partial\theta}{\partial t} = a\left(\frac{\partial^2\theta}{\partial r^2} + \frac{1}{r}\frac{\partial\theta}{\partial r}\right) \qquad (A\text{-}1)$$

where

θ = temperature,

a = the thermal diffusivity of the specimen,

t = time,

r = the radius from the source.

A solution of this partial differential equation may be developed in the following manner.

Consider unidirectional heat flow in the direction x subject to the Fourier equation:

$$\frac{\partial\theta}{\partial t} = a\frac{\partial^2\theta}{\partial x^2} \qquad (A\text{-}2)$$

with the restricting condition that $\theta = f(x)$ when $t = 0$.

Substitute in Equation A-2 $\theta = e^{bt+cx}$ where b and c are parameters, giving $b = ac^2$.

Now setting $c = \pm i\gamma$

$$\theta = Le^{-a\gamma^2 t}e^{i\gamma x}$$

or

$$\theta = Me^{-a\gamma^2 t}e^{-i\gamma x}$$

But since

$$e^{\pm i\gamma x} = \cos\gamma x \pm i\sin\gamma x$$

combining the two expressions for θ by addition and choosing suitable values of L and M gives

$$\theta = e^{-a\gamma^2 t}\cos\gamma x$$

and

$$\theta = e^{-a\gamma^2 t}\sin\gamma x$$

which are particular solutions of Equation A-2 for any value of γ. Multiply these by B and C, any functions of γ, and obtain the sum of the infinite series given by:

$$\theta = \int_{-\infty}^{\infty}(B\cos\gamma x + C\sin\gamma x)e^{-a\gamma^2 t}\,d\gamma \qquad (A\text{-}3)$$

which is also a solution of Equation A-2.

Determine functions B and C such that, for $t = 0$, Equation A-3 becomes $f(x)$ in accordance with the restriction.

Fourier's Integral gives

$$f(x) = \frac{1}{\pi}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(\lambda)\cos\gamma(\lambda - x)\,d\lambda\,d\gamma$$

and from Equation A-3 when $t = 0$ this must equal

$$\int_{-\infty}^{\infty}(B\cos\gamma x + C\sin\gamma x)\,d\gamma$$

Therefore

$$B = \frac{1}{\pi}\int_{-\infty}^{\infty} f(\lambda)\cos\gamma\lambda\,d\lambda$$

and

$$C = \frac{1}{\pi}\int_{-\infty}^{\infty} f(\lambda)\sin\gamma\lambda\,d\lambda$$

Substituting in Equation A-3 gives

$$\theta = \frac{1}{\pi}\int_{0}^{\infty} e^{-a\gamma^2 t}\,d\gamma\int_{-\infty}^{\infty} f(\lambda)\cos\gamma(\lambda - x)\,d\lambda$$

which is the required solution of θ for any values of x and t.

But since

$$\int_0^\infty e^{-n^2 g^2}\cos mg\,dg = \frac{\sqrt{\pi}}{2n}e^{-\frac{m^2}{4n^2}}$$

where m and n are arbitrary constants, it follows that:

$$\theta = \frac{1}{2\sqrt{a\pi t}}\int_{-\infty}^{\infty} f(\lambda)e^{-\frac{(\lambda-x)^2}{4at}}\,d\lambda \qquad (A\text{-}4)$$

A special form of the previous case is obtained if the surroundings have an initial temperature of 0. Consider that for each positive temperature at distance $+x$ there is an equal negative temperature at distance $-x$. To express this mathematically, suppose that for points on the positive side of the origin $x = l_1$ and on the negative side $x = -l_2$. Then l_1 and l_2 are positive and the temperature $f(x)$ can be expressed as $f(l_1)$ for the positive region and $-f(l_2)$ for the negative region. For this special case Equation A-4 can be written

(substituting $n = \frac{1}{2\sqrt{at}}$)

$$\theta = \frac{n}{\sqrt{\pi}}\left[\int_0^\infty f(l_1)e^{-n^2(l_1-x)^2}\,dl_1 + \int_0^\infty -f(l_2)e^{-n^2(l_2+x)^2}\,dl_2\right] \qquad (A\text{-}5)$$

If, instead of assuming the unidirectional flow of Equation A-2 one considers radial heat flow in a plane from a point, the differential equation becomes

$$\frac{\partial\theta}{\partial t} = a\frac{\partial^2\theta}{\partial r^2} + \frac{1}{r}\frac{\partial\theta}{\partial r}$$

or

$$\frac{\partial(r\theta)}{\partial t} = a\frac{\partial^2(r\theta)}{\partial r^2} \qquad (A\text{-}6)$$

with the restriction that

$$u = f(r) \text{ when } t = 0$$

Let $u = r\theta$ and Equation A-6 reduces to

$$\frac{\partial u}{\partial t} = a\frac{\partial^2 u}{\partial r^2} \qquad (A\text{-}7)$$

for which a solution is given by Equation A-5. Using λ as the variable of integration and remembering that $u = rf(r)$ for $t = 0$, the temperature at distance r from the point is given by

$$u = r\theta = \frac{n}{\sqrt{\pi}}\left[\int_0^\infty \lambda f(\lambda) e^{-(\lambda-r)^2\beta^2} d\lambda - \int_0^\infty \lambda f(\lambda) e^{-(\lambda+r)^2\beta^2} d\lambda\right] \qquad (A\text{-}8)$$

If the initial temperature is constant, at θ_0 within a small sphere of radius R and is 0 everywhere outside in the infinite solid, from Equation A-8

$$\theta = \frac{\theta_0}{r}\frac{n}{\sqrt{\pi}}\left[\int_0^R \lambda e^{-(\lambda-r)^2\beta^2} d\lambda - \int_0^R \lambda e^{-(\lambda+r)^2\beta^2} d\lambda\right] \qquad (A\text{-}9)$$

To reduce this finite sphere to a point source let the radius of the sphere become vanishingly small. Also, put $Q = \theta_0 C_p \rho \cdot 4/3 \pi R^3$ as the heat in the sphere, and substitute θ_0 in Equation A-9.

$$\theta = \frac{3Qn}{4C_p\theta R^3\sqrt{\pi}}\left[\int_0^R \lambda e^{-(\lambda-r)^2\beta^2} d\lambda - \int_0^R \lambda e^{-(\lambda+r)^2\beta^2} d\lambda\right] \qquad (A\text{-}10)$$

Now

$$e^{-(\lambda-r)^2\beta^2} = e^{-\lambda^2\beta^2} e^{2\lambda r\beta^2} e^{-r^2\beta^2}$$

but

$$e^x = 1 + x + \frac{x^2}{2!} + \cdots$$

so

$$e^{-(\lambda-r)^2\beta^2} = e^{-r^2\beta^2}\left(1 - 2\lambda r\beta^2 + \frac{4\lambda^2 r^2\beta^4}{2!} + \cdots\right) e^{-\lambda^2\beta^2}\left(1 + 2\lambda r\beta^2 + 4\lambda^2 r^2\beta^4 + \cdots\right) \qquad (A\text{-}11)$$

But since $0 < \lambda < R$, λ is very small and Equation A-11 becomes

$$e^{-(\lambda-r)^2\beta^2} = e^{-r^2\beta^2} e^{-\lambda^2\beta^2}\left(1 + 2\lambda r\beta^2\right)$$

Then from Equation A-10

$$\theta = \frac{3Qn}{4C_p\theta R^3\sqrt{\pi}} e^{-r^2\beta^2}\left[\int_0^R \lambda(1+2\lambda r\beta^2) e^{-\lambda^2\beta^2} d\lambda - \int_0^R \lambda(1-2\lambda r\beta^2) e^{-\lambda^2\beta^2} d\lambda\right]$$

$$= \frac{3Qn}{4C_p\theta R^3\sqrt{\pi}} e^{-r^2\beta^2}\left[\frac{4R^3 r\beta^2}{3}\right]$$

$$= \frac{Q}{k}\left(\frac{n}{\sqrt{\pi}}\right)^3 e^{-r^2\beta^2} \qquad (A\text{-}12)$$

which is the equation for the temperature distribution about an instantaneous point source in a plane. If a series of these sources be combined in a straight line an instantaneous line source will result. The magnitude of each source will be $Q\,dz$ where Q is the heat released per unit length of z. Thus summing the effect of these point sources,

$$\theta = \int_{-\infty}^{\infty} \frac{Q\,dz}{k}\left(\frac{n}{\sqrt{\pi}}\right)^3 e^{-r^2\beta^2} dz = \frac{Q}{k}\left(\frac{n}{\sqrt{\pi}}\right)^3 e^{-r^2\beta^2}\int_{-\infty}^{\infty} e^{-z^2\beta^2} dz$$

or

$$\theta = \frac{Q n^2 \beta e^{-r^2\beta^2}}{k\pi} \qquad (A\text{-}13)$$

as the temperature distribution around an instantaneous line source.

A continuous line source results upon integration of Equation A-13 in

$$\theta = \frac{Q}{4k\pi}\int_0^t \frac{e^{-\frac{r^2}{4at}}}{t} dt$$

Substituting

$$\beta = \frac{r}{2\sqrt{at}}$$

one obtains

$$\theta = \frac{Q}{4k\pi}\int_\infty^\beta \frac{e^{-\beta^2}}{\beta} d\beta = \frac{Q}{4\pi k}[I(r\beta)]$$

where the series I is given by

$$I(r\beta) = C - \log_e(r\beta) + \frac{(r\beta)^2}{2} - \frac{(r\beta)^4}{8} + \cdots$$

and if $r\beta$ is sufficiently small

$$I(r\beta) = C - \log_e(r\beta)$$

or

$$\theta = \frac{Q}{4\pi k}[C - \log_e(r\beta)]$$

Between times t_1 and t_2 the temperature rise is given by

$$\Delta\theta = \frac{-Q}{4\pi k}[\log_e(r\beta_2) - \log_e(r\beta_1)] = \frac{-Q}{4\pi k}\log_e\left(\frac{\beta_2}{\beta_1}\right)$$

or

$$\Delta\theta = \frac{Q}{4\pi k}\log_e\left(\frac{t_2}{t_1}\right) \qquad (A\text{-}14)$$

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DISCUSSION

E. R. Queer, State College, Pa., inquired about the temperature at which the probe was operated, and pointed out that the temperature might have an effect on migration of moisture. He also pointed out that the accuracy of the hot plate had been established by wide usage in many laboratories.

R. S. Dill, Washington, D. C., observed that migration of moisture still seemed to be a problem to be encountered in the use of the instrument described.

C. S. Leopold, Philadelphia, Pa., asked whether tests had been run at different time intervals to determine the effect of moisture migration.

Authors' Closure. Mr. Hooper questioned the possibility of obtaining accuracy in conductivity determinations by using the hot plate, due to the drying out of the material which would take place by the time equilibrium conditions had been established. He stated that moisture migration was not eliminated by the use of this instrument, but was obtained at the condition actually encountered in practice. Due to the short duration of the test, it could be concluded before the material had become dry.

In answer to Professor Queer, the author stated that the temperature difference in operation of the probe need only be a few degrees. Owing to the short time which had elapsed since the development of the instrument, there had been no opportunity for a complete study of its application. One present development included a small probe about 4 in. long, and of a diameter about that of a large needle, this modification having been found applicable for testing conductivity of fruits and meats.

The complete discussions, as well as the authors' closure, will appear with the paper when published in the ASHVE TRANSACTIONS.

Honored by Life Membership

L. L. Anthes
Toronto, Ont.

L. L. ANTHES, Toronto, Ont., Canada—Mr. Anthes was born in Toronto and attended Parksdale Collegiate Institute. He started in the manufacturing end of the heating and plumbing industry in 1896.

He continued through the years in manufacturing cast-iron soil pipe and fittings, pressure pipes, boilers, radiators, and warm air furnaces.

Mr. Anthes, a member of the ASHVE since 1934, served as president of the American Foundrymen's Society in 1908-09, and was its Gold Medalist in 1935, and was president of the Canadian Manufacturers Association in 1933-34. He has also served on the Management Committee and as secretary and treasurer of the Canadian Construction Association and as treasurer of the National Construction Council.

H. P. Gant
Glenmoore, Pa.

H. P. GANT, Glenmoore, Pa.—Born in Mississippi, was graduated from the University of Tennessee with a degree in electrical engineering. After six years with Western Electric Co., both in Chicago and New York, he became a member of the firm of Lewis, Robinson and Gant, Philadelphia. In 1927 the partnership was dissolved and Mr. Gant became associated with York Heating and Ventilating Corp., Philadelphia. In 1932 the corporation merged with Carrier Engineering Corp., and Mr. Gant joined Carrier. Although he retired from active business shortly before World War II, in January 1942 he joined the staff of the Philadelphia Ordnance District as director of Planning and chairman of the Board of Awards, which positions he filled continuously until July 1945.

Mr. Gant became a Member of the Society in 1915 and was elected to the Council in 1918. During his term on the Council he served as a member of the Finance and Nominating Committees, and was appointed a member of the Special Committee to Confer with the U. S. Weather Bureau. As second vice president and first vice president of the Society in 1921 and 1922, he served as chairman of the Membership Committee. He was president of the Society in 1923 and served as a member of the Society's Publication Committee.

During the following years he served on such Special Committees as Revision of Constitution, Committee to Draft a Code for Guidance of Membership Committee, Committee on Definitions, F. Paul Anderson Medal Award Committee, and as chairman of the Advisory Committee on the International Heating and Ventilating Exposition.

In 1926 he served as chairman of the Committee on Research and as a member of this committee in 1927 and 1928. In 1930 he was a member of the Committee on Code for Minimum Requirements for Heating and Ventilation of Buildings, and the following year served on the Technical Advisory Committee on Ventilation of Garages and Bus Terminals.

In his early association with the Society he became active in the affairs of the Chapter known then as the Eastern Pennsylvania Chapter, serving as its treasurer in 1918. He was elected president of the Philadelphia Chapter in 1920, and for a number of years following, he served as a member of its Board of Governors.

WILLIAM McCLINTOCK, New York, N. Y.—Mechanical Engineer, Kellex Corp., has spent his lifetime in the field of engineering design, and is the holder of 15 patents covering heating, ventilating and fire protection work. Mr. McClintock was born in Glasgow, Scotland, and received his schooling both in Scotland and in the United States.

Examples of his work are to be found in various parts of the United States, Greece, Albania and Turkey. Buildings for which he was responsible for heating, ventilating, power plant and plumbing, include schools, hospitals, libraries, museums, industrial plants, banks, arsenals, and housing projects.

His early experience was largely in the railway field, and for many years he was with Wells and Newton Co. and James McCullagh, Inc., and for a brief period served as a mechanical engineer with the

William McClintock
New York, N. Y.

U. S. War Department. He also worked for the Board of Education in New York City, and during World War II he worked on projects connected with the Atomic Research Plant at Oak Ridge, Tenn.

Mr. McClintock holds membership in the National Society of Professional Engineers, and is a licensed professional engineer in the State of New York.

L. WALTER MOON, St. Louis, Mo.—Engineer with Gilmore & Co., St. Louis, Mo. Mr. Moon, who has been in the heating,

L. Walter Moon
St. Louis, Mo.

ventilating, power piping, and air conditioning field for the past 47 years, was formerly president of the Bradley Heating Co., St. Louis. His early experience was with the Honeywell Heating Specialty Co. and includes one year with Thompson-Starrett Co., New York. The year spent with "Bill" Driscoll is described by Mr. Moon as, "worth five or six ordinary years in value of the experience gained, to say nothing of the satisfaction and pleasure of

Honored by Life Membership

being associated with one of the grandest guys in the Society."

Mr. Moon was elected a Member of the Society in 1915, and in 1921 served as a member of the Special Committee on Revision of the Constitution. As a member of Council in 1933-34-35 and 36, he served as a member of the Membership, Meetings, and Executive Committees. He also served as a member of the Society's Special Committee on Admission and Advancement from 1939-41.

He is a charter member and past president of the St. Louis Chapter of the Society, having served as president in 1928 and a member of its Board of Governors in 1924, 1929 to 1932.

Mr. Moon is a registered professional engineer in the State of Missouri.

ROBERT M. ROSEBROUGH, Webster Groves, Mo.—Central district sales manager, L. J. Mueller Furnace Co. Born in St. Louis in 1882, Mr. Rosebrough started in the heating industry in 1905, when information on heating, ventilating, and air conditioning was very limited in comparison to present day information. He conducted his own business through 1910, and in 1913 he became associated with the L. J. Mueller Furnace Co. as manager of the St. Louis branch.

Mr. Rosebrough, an active member of the St. Louis Chapter since its early days, served as secretary for two years, as the vice president in 1930 and as the president in 1931.

R. M. Rosebrough
Webster Groves, Mo.

J. O. ROSS, New York, N. Y.—Chairman of the Board of J. O. Ross Engineering Corp., he was born in Scotland. His family moved to Boston, Mass., in 1895, where he attended Technical High School and during the summer months he received his apprenticeship training with B. F. Sturtevant Co., then located at Jamaica Plain, Mass. He continued his education at night, attending Lowell Institute and taking courses conducted by M.I.T.

In 1906 he was named assistant chief engineer of heating and ventilating for the Green Fuel Economizer Co., Beacon, N. Y., and the following year was made chief engineer and manager of the fan, heating and ventilating department. In 1911 he returned to B. F. Sturtevant Co. to form a new department known as the drying department.

J. O. Ross
New York, N. Y.

During the first World War he was responsible for many new developments in drying, served on the Hoover Committee for dehydrating of vegetables, and helped develop a new type of air dryer for aircraft lumber.

In 1921 he formed his own company, the J. O. Ross Engineering Corp., specializing in all sorts of drying problems. In 1923 Ross Engineering of Canada was organized, and in 1924 Carrier-Ross Engineering Co., Ltd. of London, England, was formed.

Mr. Ross realized that air conditioning for the drying of varnish products was a large field, and with the advent of lacquers and other quick drying elements, he recognized that the future of paint finishing did not lie with air conditioning, but with high temperatures, higher than could be secured by steam. With this in mind, in 1926 Ross Engineering Corp. acquired the business of J. M. Harrison Co., a firm in Cleveland that had developed and produced a high temperature heater. This enabled Ross Engineering to immediately enter the metal finishing field. In 30 years Mr. Ross has seen his original company expand to a staff of 800, with plants in the U. S. and Canada.

ALFRED E. STACEY, JR., Syracuse, N. Y.—Process consultant, Carrier Corp., Syracuse, N. Y. Mr. Stacey, born on March 10, 1885, in Elbridge, N. Y., received his preparatory education at the Munro Collegiate Institute and obtained his M.E. degree from Syracuse University in 1906.

Alfred E. Stacey, Jr.
Syracuse, N. Y.

Following his graduation from the University, he was employed as an engineer by the Buffalo Forge Co., Buffalo, and in 1908 he joined the staff of the Carrier Air Conditioning Co., New York, as chief engineer. In 1909 he was appointed secretary and shop manager of the Elbridge Chair Co., becoming its vice president in 1911. Later that year he returned to Carrier Air Conditioning Co., as western manager with offices in Chicago. In 1919 he became chief of research at Carrier Engineering Corp., Newark, N. J. In 1928 he became vice president in charge of research, and in 1931 was appointed vice president in charge of engineering. He served as vice president of the corporation in 1934 and 1935.

With A. C. Buensod, he organized the Buensod-Stacey Air Conditioning Co., Inc., New York, N. Y., and served as vice president until he entered the Navy in 1941. During his naval service Captain Stacey made contributions to the improvement and design of naval vessels, of such importance that the military effectiveness of certain classes, particularly submarines, was materially increased, for which he received special commendation.

At the Society's 1946 Annual Meeting Captain Stacey was awarded the F. Paul Anderson Medal for his outstanding contributions to the advancement of heating, ventilating and air conditioning.

He is the author of numerous papers and reports in scientific journals in the chemical, ceramic, and textile engineering fields.

He is also a member of the American Society for Testing Materials, American Society for the Advancement of Science and the Acoustical Society of America, as well as the Delta Upsilon Fraternity.

W. G. W. Turno
East Orange, N. J.

WALTER G. W. TURNO, East Orange, N. J.—Vice president and secretary of H. W. Porter & Co., was born in New York City, where he attended City College and Columbia University, studying mechanical engineering. While still in school, he received his apprenticeship training with his father's company, the H. Turno Co., N. Y.

In 1906 he was employed by H. W. Johns-Manville Co. as draftsman and estimator. In 1927, along with several other Johns-Manville engineers, Mr. Turno incorporated H. W. Porter & Co. of Newark, N. J., to represent H. Johns-Manville as its technical service unit.

Mr. Turno is also a Life Member of the ASME and is a registered professional engineer in the states of New York and New Jersey.

President Lester T. Avery

Proceedings

ASHVE

Semi-Annual Meeting

Muskoka Lakes, Ont., Canada

June 19-21, 1950

THE 1950 Semi-Annual Meeting of the Society at the Royal Muskoka Hotel, Muskoka Lakes, Canada, provided an opportunity for 333 members and guests to enjoy the hospitality of the Ontario Chapter, and served to emphasize the close bond of friendship which exists between Canada and the United States.

While the meeting dates were June 19-21, Society work began on June 17, with a meeting of the Committee on Research at the Royal York Hotel, Toronto. This was followed by the Council Meeting at the Royal Muskoka Hotel on June 18, and numerous committee meetings during the three following days included Technical Advisory Committees, the Chapters' Conference, and Nominating and Guide Committees.

Entertainment for members and guests had been carefully planned by the committee. A ladies' tea was held on Sunday. Boat trips, golf tournaments, a frolic with square dancing and wiener roasts were some of the events.

A Welcome Luncheon, at which E. Holt Gurney, honorary chairman of the Committee on Arrangements and past president of ASHVE, was the speaker, was held on June 19. The traditional Banquet was held on June 20. H. D. Henion was the toastmaster, and John A. Marsh, M.B.E., general manager, *Canadian Exporters Association*, gave an inspiring talk on *This Canada of Ours*. His remarks were based on his experience in visiting in nearly all of the 48 states.

Eleven papers were presented at the three technical sessions held on the mornings of June 19, 20 and 21.

First Session, Monday, June 19th, 9:30 a.m.

Pres. Lester T. Avery, Cleveland, Ohio, called the Semi-Annual Meeting of 1950 to order at 9:30 a.m. in the Royal Muskoka Hotel, using for the first time in a Society Meeting the official gavel which had been presented to the Society at the April Council Meeting by the Oregon Chapter. He introduced John H. Fox, general chairman of the Committee on Arrangements, who welcomed the members and guests to Canada on behalf of the Ontario Chapter.

President Avery thanked Mr. Fox and his committee for their faithful work in making the arrangements and planning the various events for entertaining the members. President Avery also made reference to Mr. Gurney and stated that his past service to the Society was greatly appreciated.

The President emphasized the democratic operation of the Society, and expressed the hope that the Society would continue to make great progress due to the continued cooperation of members from two great democratic countries, such as Canada and the United States.

In opening the first technical session of the meeting, President Avery reminded members of the importance of these sessions and the valuable contributions of the authors of papers.

He called upon F. C. Hooper to present the first paper, **Transient Heat Flow Apparatus for the Determination of Thermal Conductivity**, by F. C. Hooper and F. R. Lepper (see page 129 in this issue).

Orifices Improve Operation

The second technical paper, **Balancing a Steam Heating System by the Use of Orifices,** by D. E. Schroeder, was presented by the author (published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, June 1950).

E. F. HYDE, Detroit, Mich. (WRITTEN): The author is to be congratulated on this fine contribution to our knowledge of orifices. It is especially valuable to know of the satisfactory results which have resulted from their use, both from the standpoint of comfort and of economy of operation.

The work of adjusting an orifice system is a laborious, long process. A method of adjusting such as the author suggests should be used, however, if the needed results are to be obtained.

The method of testing the orifices to determine the steam flow through them is unique and should serve for the application of orifices to any system employing steam above atmospheric pressure.

The comparison of steam requirements for the building tested as given in Fig. 4 over a three-year period is a very interesting way of presenting the results. The flattening of these curves between 35 and 53 F is surprising and it is to be hoped that the author will be able to account for this phenomenon later. From a practical standpoint it also would be valuable to know the overall annual steam consumption of the building so that results could be evaluated on a monetary basis.

From a consulting engineer's viewpoint in the choice of a type of heating system, there is a question as to whether an orifice system with low pressure steam or a sub-atmospheric system should be employed. The sub-atmospheric system would no doubt minimize the necessity for orifices and the results would be obtained almost immediately. If the cost of adjusting an orifice system were taken into consideration, it would seem that the sub-atmospheric system could be installed for less money than an orifice system, and the economy of operation might be expected to be even better.

In connection with an orifice system, it is noted that the author recommends that steam and condensate lines be properly sized, pitched, and clear of obstructions. These precautions are no different than for a sub-atmospheric system and should govern the installation of any type of system.

The question of whether orifices or some other means of equalizing flow should be used, however, should not in any way detract from the value of this interesting paper on the use of orifices.

G. D. WINANS, Detroit, pointed out that information on orifice performance could be found in a previously published paper*.

M. W. SHEARS, Toronto, stated that in order to select proper orifice sizes it would be necessary to know the pressure drop occurring in the piping.

JOHN JAMES, Chicago, Ill., asked the author whether the desired temperatures, which were different for various rooms, had been automatically maintained after the orifices had been installed in the system. He also mentioned that in small steam systems the main problem seems to be that of obtaining proper steam distribution. The use of orifices seems to be a method by which proper distribution could be obtained.

M. F. BLANKIN, Philadelphia, Pa., stated that in his personal experience, orifices had been used as a successful means of obtaining satisfactory steam distribution in small installations.

W. A. GRANT, Syracuse, N. Y., inquired whether the occupants opened windows in the installation described.

C. F. MALLY, Detroit, Mich., asked the author whether the design conditions assumed for selection of the orifices had been obtained in performance after installation.

AUTHOR'S CLOSURE. Mr. Schroeder stated that he had examined much of the literature available on the subject of orifice selection and performance, but that in order to make the proper selection for the installation, he had found it necessary to measure the steam flow through orifices under the conditions to be found in the installation. While the item of time for setting or installing orifices had been small, the biggest item of concern was that of computing the exact heat losses for the different rooms and selecting the orifice size. The author estimated that the savings made in one year of operation covered the entire cost of determining size and installing orifices. The author agreed with Mr. Shears that pressure losses in the piping should be known in order to make proper allowance therefor.

*Flow of Steam Through Orifices into Radiators, by S. S. Sanford and C. B. Sprenger (ASHVE TRANSACTIONS, Vol. 37, 1931, p. 371).

Research on Plant Growth

The next technical paper was **Plant Research in the Phytotron,** by Arthur J. Hess, which was presented by the author (published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, March 1950).

P. J. MARSCHALL, North Chicago, Ill., referred to the author's use of a sterile atmosphere, and stated that such a condition could probably only be obtained by passing all the air through a carbon-packed filter. He also inquired about the degree to which temperature and humidity were controlled.

E. R. QUEER, State College, Pa., stated that certain types of insects had been able to pass through filters including electrostatic precipitators, but the same insects had been eliminated by the centrifugal action of fans through which the air passed.

F. C. HOOPER, Toronto, referred to the removal of certain wavelengths of solar energy, and stated that solar heat traps could be built to collect 50 percent of the incident radiation and were therefore as efficient as growing plants.

R. A. MILLER, Pittsburgh, Pa., pointed out that by the proper use of heat absorbing glass it would be possible to obtain the same removal of certain wavelengths of solar energy as was obtained by the use of the water film on glass surface in the tests reported.

S. W. BOYD, Atlanta, Ga., asked the author to explain the method of measuring plant efficiency and the effect of

Art Hess presenting paper at First Technical Session

varying the length of day and night periods.

D. W. LOCKLIN, Cleveland, Ohio, asked for a definition of plant efficiency and the method of determining it.

AUTHOR'S CLOSURE. Mr. Hess agreed with Mr. Marschall that complete sterility of atmosphere was difficult to obtain, and that three carbon filters in series would be necessary to obtain sterile air for certain conditions. He pointed out that those who worked in the laboratory, and those who entered, were equipped with sterile garments before entering the various laboratory spaces. Mr. Hess stated that efficiency in plant growth was measured by the growth of the plant and by the quantity and size of fruit produced. The author also stated that plants could be made to grow faster by a change of length of periods of light and dark cycles.

Soil Conductivity

The last technical paper of the session, **Thermal Conductivity of Soils for Design of Heat Pump Installations**, by G. S. Smith and Thomas Yamauchi, was presented by title (published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, July 1950).

President Avery appointed the following Committee on Resolutions: Harry L. Stevens, *chairman*; H. Berkley Hedges, P. J. Marschall.

President Avery referred to the continuing growth of the Society, evidence of which is given by the receipt of applications for membership at the rate of approximately 125 a month, even though no intensive campaign for membership is being conducted. He stated that a new chapter at Dayton, Ohio, had just been chartered by the Council, bringing the total number of chapters to 44.

Announcement was made of the Welcome Luncheon at 12:15 p.m. and the session was adjourned at 12 noon.

Second Technical Session, Tuesday, June 20th, 9:30 a.m.

First Vice Pres. Lauren E. Seeley called the meeting to order at 9:30 a.m. The meeting was held aboard the SS Sagamo which cruised from 11:00 a.m. to 3:30 p.m. through Lake Rosseau and Lake Muskoka in order to permit the members to view the lake scenery and still be able to attend the technical session.

Dean Seeley introduced the authors and stated that four papers were to be presented, three of these having been prepared at the Research Laboratory and one at the Mellon Institute of Industrial Research, at the suggestion of the Committee on Research.

Design Data for Unshaded Glass

Dean Seeley called upon G. V. Parmelee to present the paper, **Heat Flow Through Unshaded Glass**, by G. V. Parmelee and W. W. Aubele (published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, June 1950).

J. Donald Krocker addressing the Chapters' Conference Committee

J. N. LIVERMORE, Detroit, Mich. (WRITTEN): I think we will all agree that this paper is a highly valuable contribution to precision in calculating heat gain through glass. It has been carefully written and reflects sound research procedure throughout.

As you may know, a joint committee, composed of members from the TAC on Heat Flow through Glass and the TAC on Cooling Load, has been assigned the task of recommending ways to present the information in this paper in a form readily usable by the practicing engineer. As chairman of this joint committee I would like to take this opportunity to invite your suggestions in this matter.

Whatever form these new data take, I would like to remind you also that a great job of condensing, perhaps with use of empirical data, will have to be done before this new information can appear on the pages of THE GUIDE. It is very likely too, that for any but the most ordinary glass and solar intensity combinations, reference must still be made to the original paper.

For this reason I would like to suggest that the authors present a supplement to the paper in which they show practical examples in which calculations demonstrate the proper application of the data they have presented.

R. W. MCKINLEY, Pittsburgh, Pa. (WRITTEN): I am convinced that this research has produced a great deal more helpful information than the authors, in their modesty, have claimed. My purpose is to ask them to set forth this helpful information in simple language so that the application engineer, architect and designer may more quickly benefit from their studies.

Granting that the authors have specialized in laboratory research rather than application engineering, I wish, nevertheless, that they had started their paper with a simple tabulation of suggested design standards and procedures based on the knowledge they have gained through their work at the laboratory. Since the designer *must* choose a *U* value and *must* estimate heating load, and cooling load, *must* lay out air distribution, choose ducts, fans, controls, and a multitude of related items, I am sure he would appreciate a great deal any application recommendation the authors might make.
For example:

1. What overall coefficients are preferable and under what circumstances?

2. Table 3 gives certain data for flat glass. Would it not be possible to add directly comparable data for glass block so that the designer would be better able to compare the performance of the two materials?

3. In the section Discussion of New Data, the authors discuss some of the reasons for differences between their *U* values and those determined by others. If this is a matter of

precision of measurement unrelated to field conditions, why not suggest the use of an average value for design purposes. If, on the other hand, the test conditions are somehow related to field conditions, I would like the authors to suggest under what design conditions they would use each set of values. Such things as these certainly would not take anything away from the scientific validity of the research and would be really helpful to those who are called on to make design decisions with limited opportunities to dig deeply into the research.

D. D'EUSTACHIO, Port Allegany, Pa. (WRITTEN): The precise measurement of heat flow and thermal conductivities is generally considered a difficult task. Much of the difficulty arises from unsuspected heat leaks and lack of true equilibrium conditions. As the authors' earlier papers show, they have taken precautions against these types of errors.

In practical situations another problem and possible source of error arises. This has to do with defining the environmental conditions which affect the heat flow. Here again the authors have been careful to describe their apparatus and state exactly how it was operated. It is, perhaps, unreasonable to expect that a paper of this character should also take the next step, namely, of setting up a procedure to enable the engineer and architect to transpose the data to the room or building with which he has to deal. This essentially requires the making of proper corrections and allowances for an environment that differs from that of the experimental set-up. The importance of doing this properly and the inherent difficulty in the process is well illustrated by the comparison the authors make between their overall U values for glass block panels and those in the current issue of THE GUIDE. They state that the 10 to 20 percent difference in these two sets of values does not arise from differences in panel conductances (here there is excellent agreement) but from the differences in evaluation of the characteristics of the indoor and outdoor environment.

Because this problem is very important and because its solution must be based on the kind of knowledge that comes from much field experience, perhaps the TAC on Heat Flow Through Glass can obtain the services of an experienced practicing engineer to suggest a procedure and to guide the work of arranging the new data in a manner that will best serve the need of Guide users.

E. W. CONOVER, Detroit, Mich. (WRITTEN): It is evident that the authors have spent considerable time in evolving theories and computing the mass of data given in this paper. After doing so, they step out of character and beyond the function of the committee under which they worked by devising Section C of Table 1. This table is not only incorrect but would seem to have no place in this paper.

Normally, the heating engineer uses the masonry opening for computing heat transmission because he does not know what kind of window is going to fill the opening. Also he is not interested in determining the percentage of exposed glass but wants a single factor or coefficient that will average his conditions. A small plus or minus differential in computed heat loss through windows is of little importance since glass transmission usually represents only 20 to 30 percent of total heat requirements. The coefficient U being based on a design condition seldom encountered, and then only at night when there is no sky or solar radiation, appears to have a considerable factor of safety in it.

In the discussion of the data it is stated, after referring to Fig. 1, that the indoor surface conductances for the calorimeter are of the order of 1.20 as compared to 1.40 to 1.50 Btu for design conditions. I cannot reconcile these figures with the curves of Fig. 1.

For the lower curves of Fig. 2 a single test result is shown for each curve, one being at a considerable variance. It is inconceivable to me that a single test point substantiates the shape and position of a computed curve.

Table 8 shows the heat gain for glass blocks I and II in south elevation to be lower at noon than at 11:00 a.m. or 1:00 p.m. while other blocks show higher. It appears that this is in error.

In this paper, as well as others by the same authors, we have looked in vain for test readings of glass temperatures, particularly those tests conducted on sunlit glass during cold weather. It seems reasonable that, due to heat storage, the transmission losses during winter daylight hours would be considerably less than for design conditions and might be even zero.

The approach to solar energy transmittance of the various types of glass seems to have been made solely from the standpoint of its effect on the summer cooling load. A similar, but opposite effect is evident on the winter heating load. I question whether the saving in summer cooling by reducing the admittance of solar energy is not counterbalanced by the increased winter heating load, especially in northern climates

View on board SS. Sagamo (C. S. Leopold in center)

SS. Sagamo in locks at Port Carling

On board SS. Sagamo

where the heating season is longer than the cooling season. This would seem to argue in favor of clear sheet glass with some type of movable control to keep out the solar energy only when desired rather than a type of glazing that reduces solar radiation at all times.

W. C. RANDALL, Detroit, Mich., asked whether tables could be provided for practical conditions showing the effect of solar radiation in reducing heating load.

LINN HELANDER, Manhattan, Kans., inquired about the effect of relative humidity on radiation loss from glass.

AUTHOR'S CLOSURE. Mr. Parmelee reviewed the purpose of the paper in improving practical design data for cooling load, and commented upon the various questions which had been raised by those who had discussed the paper. He also stated that information on surface temperatures and other data mentioned by discussers were available in the test files.

The complete closure will be published with the paper in the ASHVE TRANSACTIONS.

Paint Affects Solar Heat Absorption

Dean Seeley introduced R. H. Heilman who presented the paper, **Effective Solar Absorption of Various Colored Paints**, by R. H. Heilman and R. W. Ortmiller (published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, June 1950).

J. P. STEWART, Syracuse, N. Y. (WRITTEN): This paper is a worthwhile contribution to our knowledge of heat flow for cooling load calculations. I suggest that this excellent work be extended to include building materials such as dark, red brick, bright red brick, cream colored brick, natural color concrete, white marble and other common unpainted building materials. Other kinds of paint such as special highly reflective white paint, used for signs and road marking, may also be tested. Much used colors on Venetian blinds, such as cream or egg shell and light gray, would yield useful data for tests of Venetian blinds.

C. B. BRADLEY, Manville, N. J. (WRITTEN): The paper presents data of interest, collected and reported with the care and precision we have come to expect from the laboratory at the Mellon Institute of Industrial Research. Noteworthy is the careful description of test conditions, permitting the reader to interpret and evaluate the results quoted.

An interesting extension may be made to the authors' comments on the comparison between an aluminum and a white roof. They point out that, due to the low emissivity of aluminum and the high emissivity of white paint in the infra-red region, the aluminum roof is *usually no more effective in reducing the heat load on the roof than a good white paint*. This effect is much more pronounced at night when the roof is radiating to a sky with a very low effective temperature. The white roof, with an emissivity in the neighborhood of 0.9, radiates its heat energy very efficiently and cools off rapidly while the aluminum with a very low emissivity cools off much more slowly. Thus, much of the heat stored in the roof escapes to the surroundings in the case of the white roof, and much less is transmitted into the building.

C. S. LEOPOLD, Philadelphia, Pa., pointed out that two types of data are needed for heat absorption, one for the continuous radiation spectrum and one for the analysis of wavelengths. He mentioned that in a room certain wavelengths disappeared at each reflection due to absorption. Mr. Leopold also referred to a reported investigation in which copper phosphate added to white paint increased the emissivity of a filament lamp to 72.4 percent, from 40 percent for white paint, with only a small loss in the visible portion of the spectrum.

E. R. QUEER, State College, Pa., stated that absorption coefficients of paints could not be judged by color as seen by the eye, and therefore in many cases must be determined by test.

G. V. PARMELEE, Cleveland, Ohio, emphasized the importance of obtaining the true coefficient of radiation in order to analyze the transmission of heat through a blind made of slats where multiple radiation would be obtained from the slats.

R. A. MILLER, Pittsburgh, Pa., referred to the composition of the paints used in the tests, and stated that titanium oxide pigments in paints did not change color by aging, while lead compound pigments did change. He also cited cases in the use of camouflage paints where colors had to be correct for ocular

W. H. Old and G. H. Cummins, Detroit, waiting to board the SS. Sagamo

H. S. Johnson, New York, H. W. Pound, Louisville, and W. R. Heath, Buffalo

appearance and also had to be such as to prevent detection by photographic means.

New Psychrometric Chart

The next paper, **A Proposed Psychrometric Chart**, by H. B. Nottage, (published in the ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, July 1950) was presented by the author. Mr. Nottage pointed out that the Guide Committee had appointed a Sub-Committee consisting of T. F. Rockwell, *chairman*, David Lifton and H. B. Nottage, and that this Sub-Committee had made a study of psychrometric charts for the purpose of determining the most useful type of chart. The chart to be presented had been given consideration at a conference of engineers interested in psychrometric charts, and had also been discussed at a meeting of the International Joint Committee on Psychrometric Data. Mr. Nottage stated that the presentation of the chart at this meeting would give members an opportunity to discuss its merits, and that the discussion would have an important part in determining the suitability of the chart for publication by ASHVE.

It was pointed out that two sizes of charts were being considered, a large chart approximately the same size as the present Goff chart used in THE GUIDE, and a smaller chart which might be issued in pad form.

Mr. Nottage then explained steps taken in the preparation of the chart and discussed its use.

C. M. ASHLEY, Syracuse, N. Y. (WRITTEN): The proposed psychrometric chart presented by the author represents an important advance in understandability and usability over the present Goff Diagram for Moist Air. Whether this chart will gain general acceptance in competition with existing charts having less confusion of nearly parallel lines remains for future determination. I would question whether the chart still has attained the proper degree of usability but perhaps judgment should be reserved on this until it is possible to work with the chart in a larger size and in two colors.

It is of interest to note that the enthalpy-humidity difference ratio $\frac{h_2 - h_1}{W_2 - W_1}$ is directly related to sensible heat factor as used in my paper* in a relatively simple manner by the equation:

$$\text{Sensible heat factor} = 1 - \frac{1076}{\frac{h_2 - h_1}{W_2 - W_1} - 20}$$

In connection with the author's discussion of *sensible* and *latent* heat components whose sum makes up the *total* heat, it is of some significance to note that the total heat is not $h_1 - h_2$ but rather it is $h_1 - h_2 + (L_1 h_{w_1} - L_2 h_{w_2})$. As has been shown, this value is expressed better in terms of the sum of the sensible and latent components as related to temperature and humidity ratio difference respectively than in terms of $h_1 - h_2$ alone.

*Psychrometric Factors in the Air Conditioning Estimate, by C. M. Ashley (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, March 1949, pp. 107-114).

This chart has the advantage that a mixture condition lies on the straight line joining the two initial state points, whereas on the humidity ratio-dry bulb temperature chart it does not do so precisely. However, the deviation from a straight line on the other type of chart is extremely slight and is almost never of practical consequence.

Of particular interest is the comparison of percent saturation and relative humidity. I would like to make a strong plea for the use of relative humidity rather than percent saturation for the following reasons:

1. Relative humidity expresses the physical relationship of vapor pressure at the state point to that at saturation virtually independent of barometric pressure.

2. Relative humidity can be used above the boiling temperature of water, whereas percent saturation cannot. Also, it does have a definite physical meaning beyond this range, since it is perfectly possible to describe the pressure at saturation in this region in terms of the vapor pressure of water. It should be noted that these deficiencies of percent saturation would be particularly embarrassing in drawing psychrometric charts at higher temperatures and for other barometric pressures.

3. Relative humidity serves as a good index of the moisture content of hygroscopic materials and, unlike the relationship to percent saturation, the relative humidity-moisture content relationship is virtually unaffected by barometric pressure and can be used in the range above the boiling point of water.

4. Relative humidity has a broad acceptance and many properties are defined in terms of it.

5. Percent saturation can always be obtained by a simple computation directly from the chart, whereas relative humidity cannot. I would not for a minute argue against the utility of percent saturation in the solution of certain types of problems, but believe that it can be adequately used without having to express its values specifically on the psychrometric chart.

R. D. WOOD, Syracuse, N. Y. (WRITTEN): I would like to offer two brief comments: (1) It is believed that the final chart would have much greater acceptance by air conditioning engineers if relative humidity, rather than percent saturation, is used. (2) From the standpoint of legibility, any chart showing both enthalpy and wet bulb lines should not only be in two colors, but should be larger than 11 in. × 17 in. In other words, it should be more than twice the printed size of the chart shown in Mr. Nottage's paper.

Although the proposed chart is no doubt an improvement over the one now used in THE GUIDE, it is believed that there should be no compromise with legibility or readability if the final chart is to gain wide acceptance.

DAVID LIFTON, State College, Pa. (WRITTEN): Mr. Nottage has done an excellent job of presenting the case for

Nominating Committee members meet on board the SS. Sagamo. (*l. to r.*) *Seated*—M. F. Blankin, R. T. Kern, D. M. Mills, L. A. Burch. *Standing*—Leo Garneau, Joseph Davis, E. V. Gritton, F. W. Chambers, William Wallace, H. Fred Janssen, S. H. Downs

the proposed psychrometric chart. The Subcommittee on Thermodynamics is in complete agreement as to the desirability of a new chart so perhaps additional emphasis on some of Mr. Nottage's statements will be in order.

In a question such as this, personal experience with one type of chart will undoubtedly influence one's opinion concerning another type. Actually, the proposed chart does not depart radically from other commonly used charts and, therefore, methods of using it would not be much different from those used with other charts. It does, however, have certain advantages, the chief ones being:

1. The proposed chart is based on the best available data on the thermodynamic properties of air-water vapor mixtures instead of properties obtained from the perfect gas relationships or modifications of these relationships.

2. True values of enthalpy for any state on the proposed chart may be read directly instead of reading enthalpy at saturation, total heat or some other thermodynamically inconsistent property. Unfortunately, lines of constant enthalpy follow very closely the lines of thermodynamic wet bulb temperature and this could lead to confusion if the chart were printed in one color. It has, therefore, been proposed that the chart be published in two colors. The problems involved in reproducing such a chart are being investigated.

The proposed chart is the first one using accurate data and incorporating lines of constant enthalpy in a simple, readily usable form. As such, it represents a significant advance.

T. E. Gravenstreter, Cleveland, Ohio (Written): Mr. Nottage and the Society are to be congratulated for undertaking and bringing to a very practical conclusion a basic usable chart for the industry.

I have always felt that any information of value in the field should have for its source a non-commercial institution. Too much data in air conditioning has been compiled by firms which manufacture equipment. In this chart we have an original basic tool for the air conditioning engineer, and yet there are no popular trade names appearing on it. This work should do much to elevate the Society in its field of heating, ventilating, and air conditioning.

S. H. Downs, Kalamazoo, Mich., emphasized the importance of providing a method for making allowance for barometric pressures other than standard because most installations of air-handling equipment are made at elevations other than sea level. He also suggested that plans should be made to include a range of dry bulb temperatures higher than 125 F.

Lester T. Avery, Cleveland, Ohio, explained that one important reason for preparing a new psychrometric chart was the fact that engineers did not wish to depend on charts bearing trade names. A second reason was given as the necessity of preparing a chart containing information not now available on existing charts.

C. S. Leopold, Philadelphia, Pa., referred to the recent meeting of the International Joint Committee on Psychrometric Data at which the proposed psychrometric chart had met with a favorable reception.

W. R. Heath, Buffalo, N. Y., remarked that an excellent job had been done in preparing the chart, and he felt that it should serve as a standard from which simpler charts, suited to every-day use by the engineer, could be prepared. He mentioned the need of having charts in pad form for ready availability and for records of computations made for air conditioning installations. He also stated that it was important to have a problem-solving technique published with the chart in order to encourage the greatest possible use of the new chart.

Raymond Mancha, Pittsburgh, Pa., suggested that it is well worthwhile for any one intending to use psychrometric charts to become familiar with a chart which is based on proper fundamental and accurate principles. Familiarity with the chart would certainly increase the use and acceptance of the chart.

John Everetts, Jr., Philadelphia, Pa., requested that corrections for altitude be included on the chart, and he mentioned the U. S. Bureau of Mines Psychrometric Chart which provides corrections for pressures above and below sea level pressure. He had found need for a chart for elevations up to 7500 ft.

R. D. Madison, Buffalo, N. Y., stressed the need for education of users when introducing the new chart. He also suggested that in addition to the large accurate chart, simpler forms should also be made available.

Author's Closure. Mr. Nottage stated that all suggestions made could be considered in preparation of the final form of the chart in order that the chart would be as useful as possible. Referring to suggestions that the chart should contain corrections for pressures, the author stated that any number of charts could be made to cover the pressures desired. It seemed probable that preparation of a Research Bulletin might be advisable in order to cover adequately the subject of psychrometric charts.

On the terrace at the Royal Muskoka

Thermocouple Anemometer

The final paper, **A Simple Heated-Thermocouple Anemometer,** by H. B. Nottage (paper and discussion to be published in ASHVE Journal Section, *Heating, Piping & Air Conditioning*, September 1950), was given in outline by the author.

Cyril Tasker, director of research, reviewed briefly the work which had been done in connection with the preparation of the research papers used at the session. He gave special recognition to Mr. Parmelee and Mr. Nottage, and other members of the Laboratory staff, for their work in connection with these papers.

The meeting was adjourned at 12:15 p.m., and a buffet luncheon was served on the boat.

Third Technical Session, Wednesday, June 21, 10:00 a.m.

Second Vice Pres. Ernest Szekely called the last technical session to order at 10:00 a.m. in the Rustic Room of the Royal Muskoka Hotel.

Air Flow From Outlets

The Chairman called on Alfred Koestel to present the paper, **Comparative Study of Ventilating Jets from Various Types of Outlets**, by Alfred Koestel, Philip Hermann and G. L. Tuve (published in the ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, July 1950).

G. B. PRIESTER, Baltimore, Md. (WRITTEN): This paper is a worthwhile contribution. Comments on it from representatives of outlet manufacturers are desired and should be of interest to all. I think we should hear from them.

What the application engineer, who is usually pressed for time, needs now is a simple chart or table to aid him in quickly selecting suitable outlets for common commercial air conditioning applications. The calculation procedure, of course, could be used for special cases.

The Society certainly owes the authors an expression of thanks for their efforts in preparing and presenting their paper.

Additional discussion by Professor Helander and President Avery, together with a closure by Prof. G. L. Tuve will appear with the paper when published in the ASHVE TRANSACTIONS.

The next paper, **Energy Losses in 90-Degree Duct Elbows**, by D. W. Locklin (paper and discussion to be published in the ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, September 1950), was presented by the author, a research engineer, ASHVE Research Laboratory.

The final technical paper, **Effect of Temperature on Balance of Forced Warm-Air Systems**, by N. A. Buckley, S. Konzo, J. M. David and T. L. Towne, (see p. 119 of this issue) was presented by title since none of the authors were able to attend the meeting.

At the conclusion of the technical part of the session, Pres. Lester T. Avery assumed the chair and called for a report of the Resolutions Committee which was presented by the Chairman, Harry L. Stevens.

Golfers ready to tee off.

Resolutions

WHEREAS, THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS is concluding its 1950 Semi-Annual Meeting in the beautiful Muskoka Lakes region of Ontario, Canada, and

WHEREAS, the Ontario Chapter, through John H. Fox, its president and general chairman of arrangements, and its several committees has extended itself to insure a successful and enjoyable meeting; and

WHEREAS, the Ontario ladies have entertained our wives and families so charmingly; and

WHEREAS, E. Holt Gurney has made us feel again the warm and sincere welcome that Canada has always afforded our Society and has reminded us of the close and cordial relationship between our two great North American countries, and

WHEREAS, the authors of the technical papers and the discussion participants have made valuable scientific contributions to this Society as well as to Society at large.

NOW, THEREFORE, BE IT RESOLVED, That THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS express by unanimous vote and spread upon the minutes of this meeting a great big thank you to the Officers, the Committees and all of the members of the Ontario Chapter for providing to all those visiting them, the fine program, speakers, publicity, entertainment, transportation and other facilities for enjoyment, and to the authors and the contributors to the discussion of the technical papers and to our own Society Officers, Committees and staff.

Respectfully submitted,

RESOLUTIONS COMMITTEE
Harry L. Stevens, Chairman
H. Berkley Hedges
P. J. Marschall

Final announcement of registration for the Semi-Annual Meeting was made as follows: Members—177; Ladies—127; Guests—29; Total—333.

As there was no further business, the chairman declared the Semi-Annual Meeting of 1950 adjourned at 11:15 a.m.

Entertainment Features

Opportunities for fellowship and enjoyment of Ontario Chapter hospitality began at the Royal York Hotel, Toronto, on Saturday and Sunday when members and guests arriving in Canada found the Reception and Transportation Committees ready to give information on the best scenic route to Muskoka, and to provide transportation where needed.

With the arrival at Muskoka of 333 members, ladies and guests, it was necessary for some to use the facilities of the Rostrevor Hotel located across the lake from the Royal Muskoka. The SS Islander was assigned to the service of the meeting, and operated on a half-hour schedule to ferry members back and forth.

Afternoon Tea and Evening Movies

Tea and fruit punch were served as greetings were exchanged on Sunday afternoon in the Rustic Room of the Royal Muskoka Hotel and on the terrace overlooking Lake Rosseau.

After dinner movies were shown in the Rustic Room depicting wild life in Canada, and illustrating the measures recommended for game conservation.

Welcome Luncheon

At the Welcome Luncheon on Monday, John H. Fox, president of Ontario Chapter, presiding, the speaker was E. Holt Gurney, president of the ASHVE in 1938.

Other guests at the speakers' table who were introduced by the chairman, were Pres. Lester T. Avery, First Vice Pres. Lauren E. Seeley, Second Vice Pres. Ernest Szekely, Treasurer Reg F. Taylor, Past Pres. A. E. Stacey, Jr., N. W. Kingsland, publicity chairman and William Philip, sessions chairman.

Mr. Gurney spoke on the subject of Canada's problems. He discussed the problems encountered with foreign trade and exchange, and stated that one of Canada's great needs was American dollars. He emphasized the opportunities which Canada can provide to those interested in developing its natural resources.

The location of tremendous iron ore deposits in the Hudson Bay region, the discovery of oil in Alberta and the existence of large deposits of many important minerals were cited as factors which would contribute greatly to the development and growth of Canadian industry.

The speaker stated that Canada needs more people, and that young men of the right type would find great opportunities in Canada. He emphasized, however, that the type of people desired were particularly: *(a)* Adventurous young men; *(b)* Men interested in the humanities; *(c)* Young men who believe in private enterprise and also have political ambitions to render service to the country.

Muskoka Frolic

A combination outdoor-indoor entertainment was provided on Monday evening by square dancing in the Rustic Room, and a wiener roast on the terrace.

After an active session of dancing, the guests were treated to wieners roasted over a charcoal fire just below the terrace.

Souvenirs of the evening were straw hats and miniature canoe paddles.

Boat Trips Popular

On Tuesday, from 11:00 a.m. to 4:00 p.m., the ladies enjoyed a boat trip on the SS Sagamo through Lakes Rosseau, Joseph and Little Lake Joseph. Box lunches were eaten aboard or on shore. Many of the sightseers climbed the hill at the end of Little Lake Joseph to obtain a view of Mirror Lake.

A second excursion aboard the SS Sagamo was made on Tuesday when the technical session, as well as several committee meetings were held aboard, thus permitting many members and guests to enjoy the

The Royal Muskoka

scenery of Lakes Rosseau and Muskoka. The boat left the hotel dock at 11:00 a.m. and returned at 3:30 p.m. with a short stop at Port Carling.

Banquet

H. D. Henion of Ontario Chapter, was the toastmaster at the banquet on Tuesday evening. Each lady, when entering the room, received a corsage and a maple leaf pin as a souvenir.

Grace was said by D. A. Stott, and was followed by toasts to the King and to the President of the United States.

Guests at the speakers' table were: Toastmaster and Mrs. H. D. Henion, General Chairman and Mrs. John H. Fox, Mr. and Mrs. John A. Marsh, President and Mrs. Lester T. Avery, First Vice President and Mrs. Lauren E. Seeley, Second Vice President and Mrs. Ernest Szekely, Treasurer and Mrs. Reg F. Taylor, Secretary and Mrs. H. R. Roth, Honorary Chairman and Mrs. E. Holt Gurney, Mr. F. Aylmer Hamlet, and Mr. and Mrs. William Philip.

Past Presidents of the Society who were present at the Banquet were: E. Holt Gurney, Samuel R. Lewis, Merrill F. Blankin, Alfred E. Stacey, Jr., George L. Tuve, and Sewell H. Downs.

Much interest was shown in the award of the cups for the golf tournament in which competition had been keen for the Research, the Eichberg, and Paul Bunyan Cups. The golf awards were made by R. H. Lock, chairman of the Sports Committee.

Mr. and Mrs. Don Angus of Toronto

Mrs. H. R. Roth, Reg Taylor, and Mrs. William Philip at the Banquet

F. Aylmer Hamlet, member of Council from Montreal, introduced the Banquet speaker, John A. Marsh, M.B.E., general manager, *Canadian Exporters Association*, whose subject was *This Canada of Ours*. Beginning with a tribute to the happy relations and community of interests existing between Canada and the United States as two great independent countries of the Western Hemisphere, he drew upon his experience in visiting and speaking in nearly all of the 48 States of the United States to illustrate both similarities and differences in the two nations. He pointed out that in each there were problems to be solved by the country itself, as well as many problems which could be solved by mutual aid. Many interesting figures were quoted to show comparative resources, exports and business potentialities of the two countries, and to emphasize the importance of the United States and Canada in world affairs.

Personal invitations to the members and guests to attend the Annual Meeting in Philadelphia, in January 1951, and the Semi-Annual Meeting in Portland, Ore., in 1951, were presented by Past Pres. M. F. Blankin of Philadelphia, and J. D. Kroeker of Portland.

At the conclusion of the Banquet, the members and guests enjoyed several hours' dancing in the Rustic Room.

We are indebted to L. A. Childs, Syracuse, N. Y., and to William Wallace II, Durham, N. C., for the various snapshots used throughout these Proceedings.

SOCIETY MEMBERS RECEIVE SPECIAL AWARDS

W. M. Myler, Jr., chief engineer, Janitrol Engineering Dept., Surface Combustion Corp., and E. A. Norman, Jr., president of Norman Products Co., both of Columbus, Ohio, were awarded the *meritorious service award* of the *Gas Appliance Manufacturers Association* at its Annual Meeting in White Sulphur Springs, W. Va. This award, made annually, is in recognition of outstanding service to the gas appliance industry.

Mr. Myler and Mr. Norman, both active members in the Central Ohio Chapter of the Society, served as the chapter's presidents in 1948 and 1949, respectively.

IES ELECTS NEW OFFICERS

The *Illuminating Engineering Society*, New York has announced the election of new officers to take office October 1, 1950 as follows: *President*—Walter Sturrock, Cleveland, Ohio.

Walter Sturrock

Vice President—E. M. Strong, Ithaca, N. Y.; *Treasurer*—R. F. Hartenstein, Akron, Ohio; *General Secretary*—A. H. Manwaring, Philadelphia, Pa.; *Directors*—L. A. Hobbs, Inglewood, Calif.; and R. A. Palmer, Charlotte, N. C.

Mr. Sturrock has been associated with the General Electric Co. since 1916, active during this whole period in the development and application of improved lighting standards, especially for business office and industrial installations.

Summary of Chapter Meetings*

• **CINCINNATI**—May 25, 1950. Pres. K. B. Little called the business meeting to order at Summit Hills Country Club, Ft. Mitchell, Ky., following an afternoon of golf, baseball and dinner. R. C. Beineke, chairman of the auditing committee, presented the financial report, which was accepted by the chapter and filed as part of the May minutes.

The nominating committee presented a slate of nominees for the 1950-51 season and the secretary cast a ballot electing the following officers for the year: *President*—E. W. McNamee. *Vice President*—D. J. Wood. *Secretary-Treasurer*—J. J. Bechtol. *Board of Governors*—R. C. Beineke. The new officers were installed and the meeting was turned over to President McNamee, who presented retiring President Little with a past president's pin. Mr. Little thanked the various committee chairmen for the work which they had accomplished during the past year. President McNamee appointed the following committee chairmen for the coming year: *Program*—R. C. Beineke. *Entertainment*—H. E. Russell. *Membership*—R. J. Hanschen. *Legislative*—G. V. Sutfin.

The meeting was adjourned at 9:00 p.m. Attendance 72. Attendance ratio 0.78.

• **CONNECTICUT**—June 21, 1950. The annual summer outing was held at the Waterbury Country Club where members and guests participated in golf. Pres. D. M. Hummel presented W. K. Simpson, of the Connecticut Chapter, with a Society Life Membership Certificate. The meeting adjourned at 10:00 p.m. Attendance 46. Attendance ratio 0.19.

• **KANSAS CITY**—May 1, 1950. The meeting was called to order by Pres. Henry Nottberg, Jr., at the Aladdin Hotel Roof Garden and the minutes of the April meeting were read and approved. President Nottberg appointed an auditing committee, consisting of C. A. Flarsheim and C. E. Perry. H. H. Lewis reported that the membership committee had secured applications for 40 new members during the past year, and Mr. Lewis received the Chapter's thanks for the excellent work accomplished by the committee.

Prof. H. L. Daasch voiced his appreciation, on behalf of the University of Kansas Student Branch, for the assistance that the Kansas City Chapter had given throughout the year and during the school's annual engineering exposition.

The nominating committee presented the slate of officers for 1950-51 and a motion was made and seconded that the nominations be accepted and closed. The officers elected were: *President*—W. E. Howarth. *Vice President*—C. W. Schumacher. *Secretary*—W. A. Reichow. *Treasurer*—G. H. Stoffer. *Board of Directors*—H. A. Atwater, H. E. Degler, Henry Nottberg, Jr. Retiring President Nottberg thanked the members for the cooperation they had given him during his term of office.

The speaker of the evening, L. S. Reagan, vice president and general manager of the Webster Engineering Co., Tulsa, Okla., gave an interesting and illustrated talk on *Combustion of Natural Gas in Steam Boilers*. Following the discussion, the meeting adjourned. Attendance 83.

• **MANITOBA**—April 20, 1950. Pres. A. W. Moss called the meeting to order in Salon "A" of the Fort Garry Hotel in Winnipeg. The minutes of the March meeting were read by C. M. Fleming, secretary of the chapter, and approved as read. The slate of nominees for the coming year was presented by the nominating committee as follows: *President*—C. M. Fleming; *Vice President*—J. F. Bertram; *Secretary-Treasurer*—W. J. Atkinson; *Board of Governors*—William Adams, Einar Anderson, G. C. Davis, Ernest Lambert, W. H. McKay, A. W. Moss, A. K. Piercy, Thomas Shipley, J. R. Stephenson, and D. S. Swain. There were no further nominations and the slate was declared elected.

President Fleming introduced Mr. Midwinter, of the City Engineering Dept., and Mr. Williams, of the Publicity Dept. of the Manitoba Power Commission, who showed a colored film describing a concrete plant in Winnipeg. The meeting adjourned at 9:45 p.m. Attendance 18.

• **MONTREAL**—April 10, 1950. The meeting was held at the Berkeley Hotel and called to order by Pres. S. W. Salter. The secretary read the

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

Northern Ohio Chapter Officers Elected
(L. to R.) **G. V. Parmelee, John Richmond, W. M. Rowe, J. M. Black, R. E. Sherman, R. J. Maurer, and R. L. Byers**

minutes of the March meeting which were approved as read. The new slate of officers was officially installed and Past President Salter expressed his appreciation for the Chapter's cooperation during his term of office. Robert Clapperton reported on the arrangements which have already been made for next year's monthly meetings and suggestions from the floor were requested.

Leo Garneau introduced the speaker of the evening, S. R. Plamondon, Division of Industrial Hygiene, Ministry of Health, who spoke on *Industrial Hygiene and Its Relation with Heating and Ventilation*. Henri Dagenais thanked Mr. Plamondon for his interesting address, on behalf of the Chapter. The meeting was adjourned at 10:00 p.m. Attendance 53.

• **NEBRASKA**—May 9, 1950. The meeting was called to order by Pres. C. A. Carter at the Hotel Lincoln. President Carter selected the nominating committee, consisting of K. R. Magarrel, *chairman;* B. G. Peterson and Verne Simmonds. He also appointed L. A. Ferguson and J. D. Edwards to tally the ballots.

The speaker of the evening was Prof. F. B. Rowley, director, Engineering Experiment Station, and head, department of mechanical engineering, University of Minnesota, Minneapolis, who spoke on *Insulation and Condensation*. Professor Rowley's subject was extremely interesting and dealt with the heat transfer through air spaces and insulating materials. He also discussed surface temperatures and temperature gradients through various assembled insulating materials. The meeting adjourned at 9:30 p.m. Attendance 57. Attendance ratio 0.24.

• **NORTHEASTERN OKLAHOMA**—May 16, 1950. Members and guests met at Smith's Restaurant at 6:30 for a dinner meeting. The vice president opened the meeting at 7:30 and the secretary called the roll and read the minutes of the March meeting, which were approved as read. A short general discussion was held relative to stimulating attendance and the nature of future programs. A motion picture, *Lifelines of Industry*, was shown through the courtesy of the Crane Co. The meeting was adjourned at 8:35 p.m. Attendance 13. Attendance ratio 0.30.

• **ONTARIO**—May 1, 1950. The business meeting was called to order at 7:30 p.m. by Pres. A. J. Strain. The minutes of the preceding meeting were read and accepted as written. The various committee chairmen made their reports, after which N. W. Kingsland presented a Life Membership Certificate to L. L. Anthes.

F. G. Ewens, assistant professor of mechanical engineering, University of Toronto, presented the University Award to B. M. Hardy, a student of engineering at the University, who wrote a thesis on *A Progress Report on a Heat Pump Installation*.

The secretary announced the officers elected for the coming year as follows: *President*—J. H. Fox; *Vice President*—William Philip; *Secretary-Treasurer*—H. R. Roth; *Board of Governors*—N. W. Kingsland, G. P. Cooper, J. H. Ross, and A. J. Strain. President Strain thanked the chapter for the splendid cooperation given him during the past year, especially by the various committee chairmen and committee personnel. He then presented the gavel to incoming President Fox who presented Mr. Strain with a past president's certificate from the Ontario Chapter. H. D. Henion presented Mr. Strain with a diamond-studded past president's emblem.

R. O. Hurst, Dean of Ontario College of Pharmacy, was introduced by President Fox. Dean Hurst spoke on *King Alfred Was Right*. After the talk, A. G. Ritchie extended a vote of thanks, on behalf of the chapter, to Dean Hurst. Attendance 80. Attendance ratio 0.35.

• **OREGON**—May 4, 1950. The members and guests met at the Old Heathman Hotel, and Pres. R. C. Chewning called the meeting to order. The secretary read the minutes of the April meeting, which were approved as read. The guest speaker of the evening, Prof. G. S. Smith, department of electrical engineering, University of Washington, Seattle, was introduced by President Chewning. Professor Smith presented a preview of his paper, *Thermal Conductivity of Soils for Design of Heat Pump Installations*, which is to be presented at the Semi-Annual Meeting at Muskoka. The topic was very ably presented by Professor Smith, who answered many questions from the audience at the conclusion of his talk.

President Chewning announced that the Society will hold the 1951 Semi-Annual Meeting in Portland and that B. W. Farnes had accepted the general chairmanship for that meeting. Mr. Farnes then reported on the tentative plans for the meeting and announced the appointment of various committee chair-

men. The meeting adjourned at 10:25 p.m. Attendance 64.

• **ROCKY MOUNTAIN**—May 17, 1950. Dinner preceding the meeting was held at the Silver Wing Inn. The meeting was called to order by Pres. E. J. McEahern at 8:00 p.m. and the reading of the minutes of the preceding meeting was dispensed with, since this meeting was a social meeting of members and their wives combined with the election of officers.

The financial report for the entire year was given by the treasurer. The officers elected for the year 1950-51 are as follows: *President*—R. W. Petersen; *Vice President*—B. H. Spurlock, Jr.; *Secretary*—P. C. Von Rosenberg; *Treasurer*—P. W. Young. *Board of Governors*—A. W. Cooper, Fred Janssen, and E. J. McEahern. Attendance 59. Attendance ratio 0.49.

• **ST. LOUIS**—May 2, 1950. The meeting was called to order by Pres. W. A. Russell at the York Hotel and the minutes of the April meeting were read and approved. Following reports of the various committee chairmen, W. A. Klein made an interesting, humorous and historical presentation of a Life Membership Certificate to L. Walter Moon, who joined the Society in 1915, three years before the St. Louis Chapter was organized. Mr. Moon responded with an equally clever speech and covered almost everything except how he keeps from having gray hair.

Following this, the nominees recommended by the nominating committee were elected and installed as the new officers for the 1950-51 season. Past Pres. R. M. Rosebrough inducted his son, J. S. Rosebrough, into office as president. He, in turn, presented his father with a Life Membership Certificate. President Rosebrough also presented a past presidents' pin to retiring President Russell.

The guest speaker of the evening A. B. Campbell, assistant general sales manager and director of personnel training, Ralston Purina Co., spoke on *Contagious Enthusiasm*. Mr. Campbell's speech proved to be definitely contagious and all who heard him were full of enthusiasm for his message and, according to the report of the secretary, it was one of the best talks given during the 1949-50 season. The meeting adjourned at 9:45 p.m. with a rising vote of thanks to Mr. Campbell for his inspiring talk. Attendance 38.

• **SOUTH TEXAS**—May 19, 1950. Pres. R. J. Salinger called the meeting to order at Bill Williams' Restaurant. The secretary read the minutes of the preceding meeting which were approved as read. The officers elected for the 1950-51 season are as follows: *President*—H. W. Broadwell; *Vice President*—G. J. Collins; *Secretary*—C. L. Fleming; *Treasurer*—E. G. Floeter; *Board of Governors*—J. W. Holland, F. M. Neil.

R. H. Wittbold, chairman of the program committee, introduced I. A. Naman, consulting engineer, Houston, Tex., who spoke on *Engineer-Contractor Relationship*. After briefly outlining some of the problems encountered by the consulting engineer in his relations with the contractor, Mr. Naman invited an open forum discussion from the floor. A lively general discussion, with comments from attending contractors, sales engineers and consulting engineers, followed. The meeting was adjourned at 10:30 p.m. Attendance 69. Attendance ratio 0.30.

• **SOUTHERN CALIFORNIA**—May 17, 1950. After dinner at the Conde French Restaurant, the business meeting was called to order by Pres. J. L. Blake. A. J. Hess, of the teller's committee, reported the election results for the year 1950-51 as follows: *President*—L. J. Helms; *Vice President*—M. C. Greiner; *Secretary*—J. S. Earhart; *Treasurer*—L. B. Davenport; *Board of Governors*—J. L. Blake, R. S. Farr, A. J. Hess, Harry Kunkle, and R. A. Lowe.

Mr. Davenport, the program chairman, introduced R. H. Phillips, branch manager, Carrier Corp., Los Angeles, who spoke on *Conduit Type Air Conditioning Systems*. Mr. Phillips discussed the design and application of this relatively high pressure system and showed very interesting color slides of the equipment and typical installations. The program was enjoyed and the meeting was adjourned at 10:30 p.m. Attendance 75. Attendance ratio 0.31.

• **SOUTHWEST TEXAS**—June 20, 1950. The meeting was called to order by Pres. L. S. Pawkett in the Tapestry Room of the St. Anthony Hotel, and the minutes of the preceding meeting were approved as written. W. E. Long, secretary, gave a report on the Sixth Annual Southwest Air Conditioning Conference to be held at the University of Texas, Austin, on December 4, 5, and 6, 1950. He also requested more personal responsibility and interest in getting other members to attend the meetings. Members were also urged to contact non-members who have been attending the meetings regularly and encourage them to apply for membership.

I. W. Wilke introduced Dr. W. A. Cunningham of the chemical engineering department, University of Texas, who spoke on *The Chemical Industry of Texas*. Dr. Cunningham stated that the increased interest in the Texas chemical industry is created by increased demands for chemical products in the southwestern United States and by the abundance of raw materials in this state.

Dr. Cunningham's talk was interesting and informative and well received. An interesting discussion period followed. The meeting adjourned at 10:15 p.m. Attendance 20. Attendance ratio 0.35.

• **VIRGINIA**—May 17, 1950. Members and guests met in the auditorium of the Pepsi Cola Bottling Co. of Norfolk, Inc., and the business meeting was called to order by Pres. W. P. Robinson. The minutes of the April meeting were read and approved. Laurence Trant, chair-

man of the membership committee, spoke briefly on membership in the Society. J. E. White then introduced the speaker of the evening, P. R. Achenbach, assistant chief, Heating and Air Conditioning Section, Government Research Laboratory, National Bureau of Standards, Washington, D. C., who spoke on *Research on Warm Air Heating of Basementless Houses*. Mr. Achenbach described a small frame house with a heat loss of 33,000 Btu per hr with 0 F outside and 70 F inside, where he carried on experiments to determine the best location of terminals and returns, rate of air circulation, and performance of control settings. He stated that in some experiments the heat was provided by an electric heater with about the same heat mass as the usual stove used in a small frame house. This heater provided from 2000 to 50,000 Btu per hr and could be controlled at increments of 2000 Btu per hr. Many slides were used to illustrate results of the experiments. They indicated that with 0 F outside, a gravity system was unsatisfactory but with 20 F outside, it did a satisfactory job. According to the secretary's report, Mr. Achenbach's talk was very interesting, especially to those small home owners among the group. Attendance 25. Attendance ratio 0.53.

STUDENT BRANCHES

▲ **CCNY**—May 17, 1950. The meeting was called to order by Pres. Seymour Oestreicher at 5:00 p.m. The final reports by the chairmen of the various committees were read and accepted by the chapter. Election of officers for the fall 1950 semester was held with the following results: *President*—Seymour Weinberg; *Vice President*—D. L. Weinberg; *Secretary*—Benjamin Karp. The newly elected officers were introduced by the retiring officers. Plans were made to seek new members for the Student Branch from that group of interested students still taking their pre-engineering courses. The meeting was adjourned at 6:00 p.m. Attendance 28. Attendance ratio 0.56.

▲ **PURDUE UNIVERSITY**—May 24, 1950. Chairman D. M. Williams opened the meeting in the Purdue University Mechanical Engineering Building at 7:45 p.m. After the completion of the chapter business, the following students were elected to fill the vacancies in the executive committee due to the June graduation: J. J. Harrell; June Cox; Stanley Kalfus; S. R. Jacob; and Robert Weiss. The business meeting was adjourned at 8:15 p.m. and was followed by a social meeting during which refreshments were served. Attendance 16.

SMA HOLDS ANNUAL MEETING

The Stoker Manufacturers Association held its 1950 Annual Meeting on Thursday, June 15, at the La Salle Hotel, Chicago, Ill.

At the Fourth Annual Technical Conference sponsored by the *SMA* Engineering and Research Committee, the speakers included Harlan Nelson, Battelle Memorial Institute, Columbus, Ohio; Dr. R. C. Johnson, vice president of research, Anthracite Institute, Wilkes-Barre, Pa.; John W. James, chief research engineer, McDonnell & Miller, Inc., Chicago, Ill.; and Dr. L. C. McCabe, U. S. Bureau of Mines, Washington, D. C. Mr. Nelson gave a very excellent summary of the progress on the standard test procedure project for domestic bituminous stoker coals, jointly sponsored by Bituminous Coal Research and *SMA*. Dr. Johnson gave a description of developments in burning equipment in the anthracite industry. Mr. James presented an up-to-date and complete review of developments and trends in modern heating systems, and Mr. McCabe reviewed national developments and progress in air pollution and smoke control and showed some extraordinary color slides of the *smog* conditions in Los Angeles.

The usual business of the Association, reports of officers, committees, etc., was accomplished in minimum time. The three speakers, Vance Jewson of Minneapolis-Honeywell Regulator Co., Joseph Meek, of the Illinois Federation of Retail Associations, and Julian Tobey, of Appalachian Coals, Inc., each in his own way and in his own field, represented one of the best speaking programs in *SMA* history.

The following were elected to serve as members of the Board of Directors for the ensuing fiscal year, which started July 1, 1950: C. T. Burg, *Chairman*, Cleveland, Ohio; T. A. Crawford, Detroit, Mich.; L. C. Dubs, Canton, Ohio; B. O. Fink, Auburn, Ind.; G. W. Graham, Chicago, Ill.; Frank Hoke, Indianapolis, Ind.; J. M. McClintock, Chicago, Ill.; C. P. Meredith, Springfield, Ohio; and C. A. Potts, Lebanon, Ind. At a meeting of the new Board of Directors, the following officers were elected: *President*—C. T. Burg; *Vice President*—L. C. Dubs; *Secretary-Treasurer*—T. A. Crawford; *Executive Secretary*—M. G. Bluth.

BUREAU OF STANDARDS ANNOUNCES NEW PUBLICATION

A concise, readable presentation of the problem of undesirable household and industrial odors together with practical methods for their control, is given in a new circular, *Control of Odors*, published by the *National Bureau of Standards*. This pamphlet, now available from the Government Printing Office, is based on research conducted at the Bureau and on critical consideration of the extensive technical literature on odor control. The limited usefulness of adsorbents, particularly in homes, is discussed.

National Bureau of Standards Circular 491, Control of Odors, of 12 pages, is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 10 cents a copy. Remittances from foreign countries should be in United States exchange and should include an additional sum of one-third the publication price to cover the cost of mailing.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month, 53 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by August 25, 1950, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

ANGUS, GEOFFREY, Chief Engr., Waterman-Waterbury Mfg. Co., Regina, Sask., Canada. REFERENCES: G. E. Cole, D. L. Lindsay, H. M. Treleaven, G. L. Wiggs.

AYRES, R. O., JR., Sales, Ayres & Co., Houston, Tex. REFERENCES: R. O. Ayres, Sr., E. G. Floeter, Jr., R. B. Johnson, Norman Way.

BERINGER, W. J., Vice-Pres. and Gen. Mgr., Aqua-Therm, Inc., Dayton, Ohio. REFERENCES: Joseph Fletcher*, P. G. McDermott*, R. J. Perkins, C. A. Rauh*.

BREWSTER, T. W., Pres., Alco Air Conditioning Engineers, Ltd., Toronto, Ont., Canada. REFERENCES: L. M. Bennett, A. M. Dion, J. H. Ross, W. J. Usher, Jr.

BRUCE, H. H., Tech. Dir., Invisible Panel Warming Association, London, England. REFERENCES: G. N. Haden, W. W. Nobbs, Cyril Tasker, L. C. Watts.

COATES, J. D., Sales, Bawden Machine Co., Ltd., Toronto, Ont., Canada. REFERENCES: Thomas Ferguson, Ernest Fox, J. A. Norton, William Philip.

CORY, NELSON, JR., Owner, Cory Automatic Heating Co., San Antonio, Tex. REFERENCES: F. C. Benham, Jr., L. C. Ferrell, L. H. Hornor, Jr., L. S. Pawkett.

CRAWFORD, H. A., Pres., Crawford Furnace Co., Columbus, Ohio. REFERENCES: A. T. English, N. T. Hess, W. M. Myler, Jr., R. J. Schmitz, Jr.

FOX, HAROLD, Engrg. Supt., Cotter Bros., Ltd., Winnipeg, Man., Canada. REFERENCES: E. J. Argue, William Glass, A. W. McCallum, D. S. Swain.

FRIENDLY, SOLOMON, Owner, Sol Friendly Sheet Metal Works, Toronto, Ont., Canada. REFERENCES: F. G. Ewens, F. C. Hooper, W. G. McIntosh*, R. C. Wiren*.

FROST, W. A. E., Heating Engr., C. A. Dunham Co., Ltd., Toronto, Ont., Canada. REFERENCES: M. C. Bailey, A. J. Dickey, H. D. Henion, M. W. Shears.

GETTIER, B. M., Marine Engrg. Draftsman, Norfolk Naval Shipyard, Portsmouth, Va. REFERENCES: J. M. Barber*, T. W. Beard*, T. A. Lambert*, R. C. Thomas.

GIFFIN, D. P., Pres., Giffin Sheet Metals, Ltd., Toronto, Ont., Canada. REFERENCES: W. H. Evans, J. H. Fox, G. S. McKernan, H. R. Roth.

GUTHRIE, W. S., Assoc. Prof., A. & M. College of Texas, College Station, Tex. REFERENCES: C. W. Crawford*, V. M. Faires*, L. S. O'Bannon, J. A. Whitacre, Jr.

HADRA, C. M., Mech. Engr., Paul O. Rottman, Cons. Engr., Shreveport, La. REFERENCES: R. M. Hood, M. A. Hudson, P. O. Rottmann, R. L. Sigler.

HELLMAN, A. A., Chief Mech. Engr., Arthur Froehlich, Architect, Beverly Hills, Calif. REFERENCES: M. C. Greiner, L. J. Helms, A. J. Hess, R. F. Pyle.

HUNTER, J. T., JR., Estimator, Starr Davis Co., Inc., Greensboro, N. C. REFERENCES: B. T. Nash, G. B. Rottman, W. H. Sullivan, W. H. Sullivan, Jr.

HUTCHEON, N. B., Prof., Mechanical Engineering, University of Saskatchewan, Saskatoon, Sask., Canada. REFERENCES: W. H. Evans, J. H. Fox, I. M. Fraser, R. A. Spencer.

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Boston, Mass.

Word has been received of the death, on June 18, of Ralph R. Emerson, president, Emerson, Swan, Goodyer Co. and a member of ASHVE since 1922.

Mr. Emerson was born in Richford, Vt., on September 8, 1882 and attended school there. He received his apprenticeship training with Phelps Bros., Barre, Vt., and Peck Bros., Montpelier, Vt., after which he spent eight years as a journeyman with various companies in New England. The next nine years he spent with American Radiator Co. in its New York branch offices. From that time until 1932 he was associated with the Hoffman Specialty Co., of New York. In 1933 he organized the firm of Emerson, Swan, Goodyer Co.

He is survived by his widow and one daughter, to whom the Officers and Council of the Society extend their sincere sympathy.

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● **KANSAS CITY:** Organized 1917. Headquarters, Kansas City, Mo. Meets, First Monday. PRESIDENT, W. E. Howarth, 101 W. 11th St., Kansas City 6. SECRETARY, W. A. Reichow, 7331 Madison, Kansas City 5.

● **MANITOBA:** Organized 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. PRESIDENT, C. M. Fleming, 116 Osborne St., Winnipeg, Man. SECRETARY, W. J. Atkinson, 812 Boyd Bldg., Winnipeg.

● **MASSACHUSETTS:** Organized 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. PRESIDENT, D. W. Blair, 87 Withington Rd., Newtonville 60. SECRETARY, W. A. Williams, 10 Sevinor Rd., Marblehead.

● **MEMPHIS:** Organized 1944. Headquarters, Memphis, Tenn. Meets, Third Monday. PRESIDENT, C. S. Fischer, 367 Adams Ave., Memphis. SECRETARY, A. T. Bevil, 1521 Waverly Ave., Memphis 6.

● **MICHIGAN:** Organized 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. PRESIDENT, C. F. Donohoe, 2000 Second Ave., Detroit 26. SECRETARY, R. H. Oberschulte, 316 McKerchey Bldg., Detroit 1.

● **MINNESOTA:** Organized 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. PRESIDENT, G. M. Kendrick, 402 Essex Bldg., Minneapolis 2. SECRETARY, J. V. Borry, 6433 Second Ave., Minneapolis 19.

● **MONTREAL:** Organized 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. PRESIDENT, R. R. Noyes, Rm. 674, Sun Life Bldg., Montreal. SECRETARY, T. G. Anglin, 540 Prince Albert Ave., Montreal 6.

● **NEBRASKA:** Organized 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. PRESIDENT, G. W. Colburn, 2865 Ida St., Omaha. SECRETARY, S. W. Black, 18th and Harney Sts., Omaha.

● **NEW YORK:** Organized 1911. Headquarters, New York, N. Y. Meets, Third Monday. PRESIDENT, Carl F. Kayan, Columbia University, Morningside Hgts., New York 27., SECRETARY, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

● **NORTH CAROLINA:** Organized 1939. Headquarters, Durham, N. C. Meets, Quarterly. PRESIDENT, M. F. DuChateau, 205 S. Lyndon St., Greensboro. SECRETARY, G. B. Rottman, 401 S. Chapman St., Greensboro.

● **NORTH TEXAS:** Organized 1938. Headquarters, Dallas, Tex. Meets, Third Monday. PRESIDENT, Herman Blum, 2812 Fairmount, Dallas 4. SECRETARY, R. E. Allison, 607-11 First Ave., Dallas 10.

● **NORTHEASTERN OKLAHOMA:** Organized 1948. Headquarters, Tulsa, Okla. PRESIDENT, A. D. Holmes, 323 W. First St., Tulsa. SECRETARY, J. N. Watt, 528 E. Fifth St., Tulsa.

● **NORTHERN OHIO:** Organized 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. PRESIDENT, W. M. Rowe, 1302 Swetland Bldg., Cleveland 15. SECRETARY, G. V. Parmelee, 94 Solon Rd., Chagrin Falls.

● **OKLAHOMA:** Organized 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. PRESIDENT, R. E. Swan, 2 N. W. Sixth St., Oklahoma City. SECRETARY, W. J. Collins, Jr., 2240 Oklahoma Natural Gas Bldg., Oklahoma City.

● **ONTARIO:** Organized 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. PRESIDENT, J. H. Fox, Vanderhoof Ave., Leaside, Toronto 17. SECRETARY, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

● **OREGON:** Organized 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. PRESIDENT, R. C. Chewning, 402 Failing Bldg., Portland 4. SECRETARY, Dick Blankenship, 725 Cascade Bldg., Portland 4.

● **PACIFIC NORTHWEST:** Organized 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. PRESIDENT, C. A. Pangborn, 312 2nd and Cherry Bldg., Seattle 4. SECRETARY, W. B. Pride, 3111 Dose Terrace, Seattle 44.

● **PHILADELPHIA:** Organized 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. PRESIDENT, J. W. McElein, 1926 Lycoming Ave., Overlook Hills, Willow Grove. SECRETARY, L. M. Church, 12 S. 12th St., Philadelphia 7.

● **PITTSBURGH:** Organized 1919. Headquarters, Pittsburgh, Pa. Meets, Second Monday. PRESIDENT, A. F. Metzger, 435 Sixth Ave., Pittsburgh 22. SECRETARY, F. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

● **ROCKY MOUNTAIN:** Organized 1944. Headquarters, Denver, Colo. Meets, First Wednesday. PRESIDENT, R. W. Petersen, 2115 S. Gilpin St., Denver 10. SECRETARY, P. C. Von Rosenberg, 1875 S. Cook St., Denver.

● **ST. LOUIS:** Organized 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. PRESIDENT, J. S. Rosebrough, 75 Rosemont Ave., Webster Groves, 19. SECRETARY, L. L. Hamig, 1706 Olive St., St. Louis 7.

● **SHREVEPORT:** Organized 1918. Headquarters, Shreveport, La. Meets, Third Thursday. PRESIDENT, B. F. Segall, Jr., 603 Cotton St., Shreveport. SECRETARY, R. M. Hood, 411 Louisiana Ave., Shreveport.

● **SOUTH TEXAS:** Organized 1938. Headquarters, Houston, Tex. Meets, Third Friday. PRESIDENT, H. W. Broadwell, 2201 Texas Ave., Houston. SECRETARY, C. L. Fleming, 805-A, M & M Bldg., Houston.

● **SOUTHERN CALIFORNIA:** Organized 1930. Headquarters, Los Angeles, Calif. Meets, Third Wednesday. PRESIDENT, L. J. Helms, 3357 Fairmount Ave., La Crescenta, Calif. SECRETARY, J. S. Earhart, 2734 Fleur Dr., San Marino 9, Calif.

● **SOUTHWEST TEXAS:** Organized 1946. Headquarters, San Antonio, Tex. Meets, Third Tuesday. PRESIDENT, L. S. Pawkett, 816 Insurance Bldg., San Antonio 5. SECRETARY, W. E. Long, Mechanical Engineering Dept., University of Texas, Austin.

● **UTAH:** Organized 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, C. E. Ferguson, 838 E. Garfield Ave., Salt Lake City. Secretary, A. R. Curtis, 2211 Highland Dr., Salt Lake City.

● **VIRGINIA:** Organized 1946. Headquarters, Norfolk, Va. Meets Third Wednesday. PRESIDENT, W. P. Robinson, 1442 Ocean View Ave., Norfolk 3. SECRETARY, D. E. Phillips, P.O. Box 674, Newport News.

● **WASHINGTON, D. C.:** Organized 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. PRESIDENT, F. M. Thuney, 1919 K St., N. W., Washington 6. SECRETARY, I. M. Bortman, 422 Luray Pl., N. W., Washington 10.

● **WESTERN MICHIGAN:** Organized 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. PRESIDENT, K. E. Robinson, 211 Smith Ave., Lansing 10. SECRETARY, F. W. Brundage, 512 N. Park St., Kalamazoo 11.

● **WESTERN NEW YORK:** Organized 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. PRESIDENT, F. J. Weber, 443 Delaware Ave., Buffalo 2. SECRETARY, J. M. Quackenbush, 505 Franklin St., Buffalo 2.

● **WISCONSIN:** Organized 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. PRESIDENT, F. J. Nunlist, Jr., 2005 W. Oklahoma Ave., Milwaukee 7. SECRETARY, N. E. Hill, 122 N. Hartwell Ave., Waukesha, Wis.

Student Branches

● **COLLEGE OF CITY OF NEW YORK:** Organized 1949. Headquarters, New York, N. Y. PRESIDENT, Seymour Oestreicher, 2009 Bryant Ave., New York 60. SECRETARY, Murray Goldman, 2075 Fulton St., Brooklyn 33.

● **LOUISIANA POLYTECHNIC INSTITUTE:** Organized 1949. Headquarters, Ruston, La. PRESIDENT, C. W. Gorton, 301 S. Trenton, Ruston. SECRETARY, A. L. Jones, Jr., Apt. 40, Vetville, La. Tech. Station, Ruston.

● **NORTH CAROLINA STATE COLLEGE:** Organized 1948. Headquarters, Raleigh, N. C. PRESIDENT, J. J. Andrews, 710 Harvey St., Raleigh. SECRETARY, E. A. Stroupe, Jr., 416 Halifax St., Raleigh.

● **OKLAHOMA A. & M. COLLEGE:** Organized 1950. Headquarters, Stillwater, Okla. PRESIDENT, R. E. Metzkier, 14-E Midi. Box 563, Veterans Village, Stillwater. SECRETARY, W. D. Jenkins, 801 W. Walnut, Enid.

● **OREGON STATE COLLEGE:** Organized 1949. Headquarters, Corvallis, Ore. Meets, First Wednesday after First Tuesday. PRESIDENT, M. B. Larson, 2311 N. E. Hancock, Portland 12. SECRETARY, Helen P. Lankow, 1349 S. E. Birch St., Portland 14.

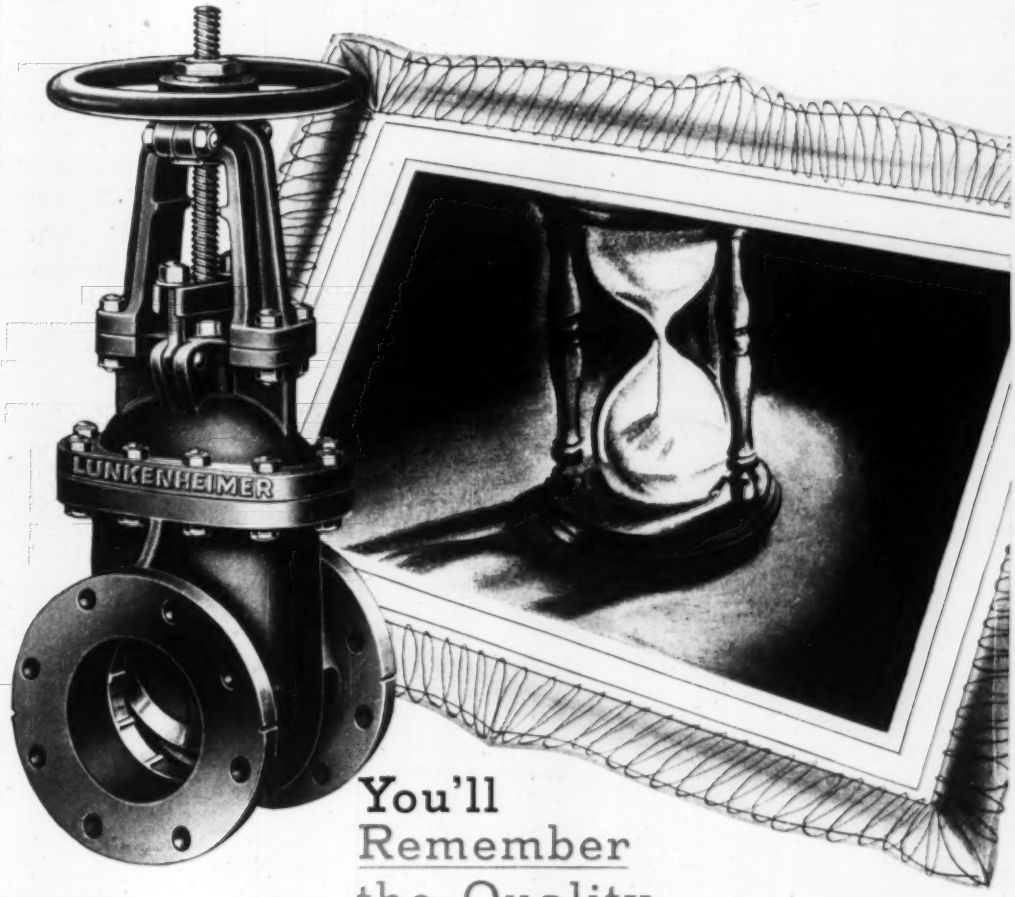
● **PURDUE UNIVERSITY:** Organized 1948. Headquarters, W. Lafayette, Ind. CHAIRMAN, John Harrell, 325 S. Chauncey, W. Lafayette, Ind. SECRETARY, Miss June Cox, 403 Maple, W. Lafayette, Ind.

● **TEXAS A. & M. COLLEGE:** Organized 1946. Headquarters, College Station, Tex. Meets, Second and Fourth Tuesday. PRESIDENT, John E. Schuimann, Texas A. & M. College, General Delivery, College Station, Tex. SECRETARY, A. G. Seelke, Jr., Box 4251, College Station.

● **UNIVERSITY OF DETROIT:** Organized 1949. Headquarters, Detroit, Mich. Meets First Tuesday. PRESIDENT, L. M. Blanchette, 2245 Holcomb, Detroit 14. SECRETARY, S. H. Kosinski, 4439-30th, Detroit 10.

● **UNIVERSITY OF KANSAS:** Organized 1949. Headquarters, Lawrence, Kans. PRESIDENT, J. L. Williams, 5278 Central, Kansas City, Mo. SECRETARY, R. C. Umholtz, 2732 Michigan St., Topeka, Kans.

● **UNIVERSITY OF TEXAS:** Organized 1949. Headquarters, Austin, Tex. Meets, First and Third Tuesday. PRESIDENT, L. T. Davis, 4409 Avenue C., Austin. ACTING SECRETARY, L. E. Scott, 1221-D Brackenridge Apts., Austin.



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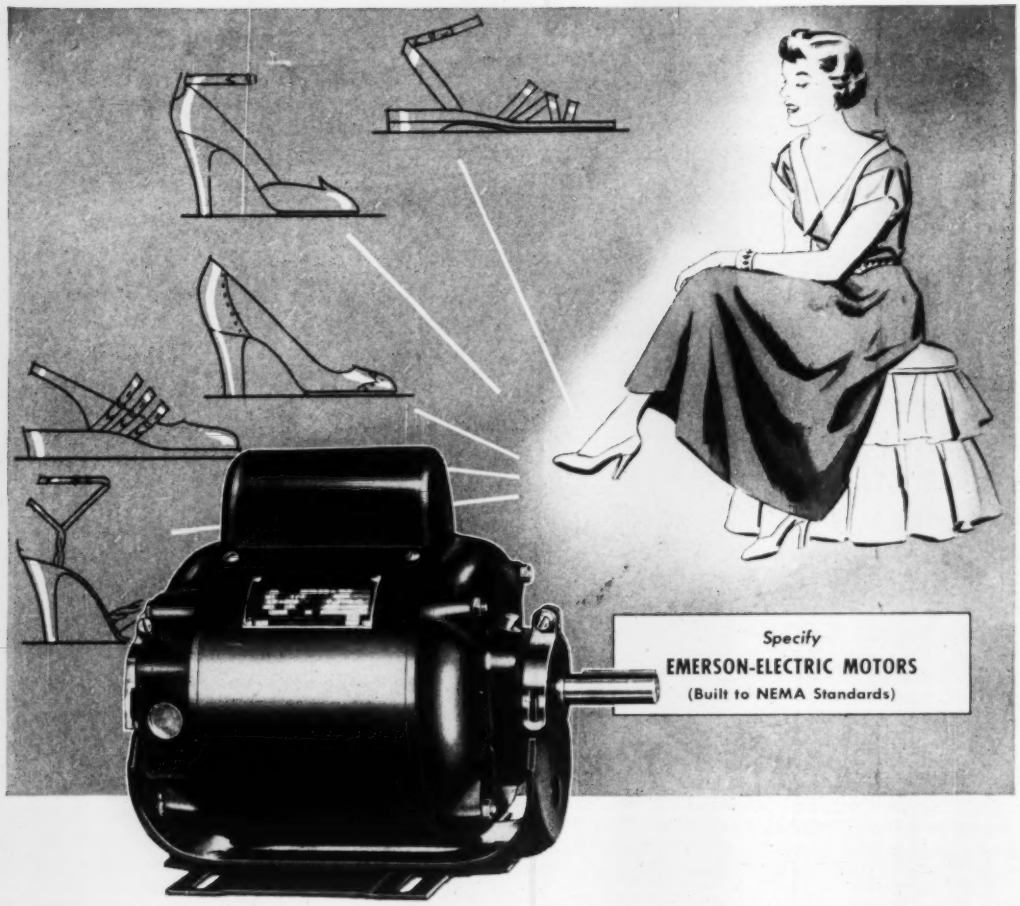

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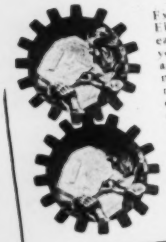

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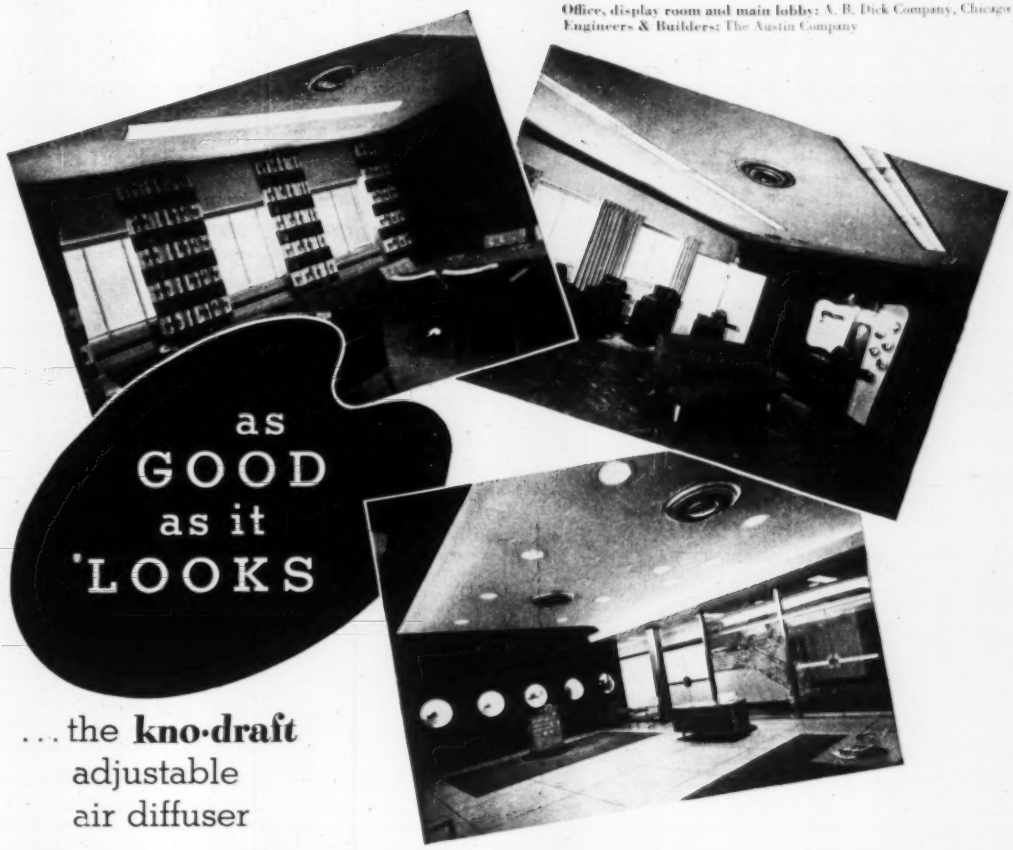

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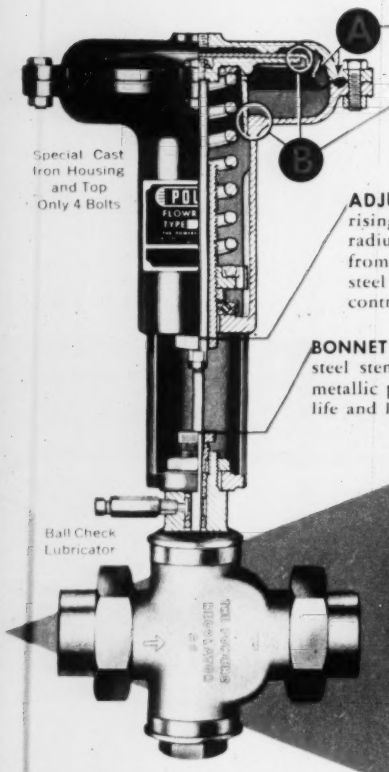

VALVE TOP—Durable moulded neoprene diaphragm (A) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (B) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment.

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BONNET ASSEMBLY—Polished stainless steel stem in preformed lubricated metallic packing insures long life and low hysteresis.

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For line pressures up to 250 lbs. per square inch. Rugged construction to withstand piping strains. Single seat or double seat, bronze and stainless steel trim. Double unions and flanged ends. Available normally open (direct acting) or normally closed (reverse acting) and 3-way mixing type valves.

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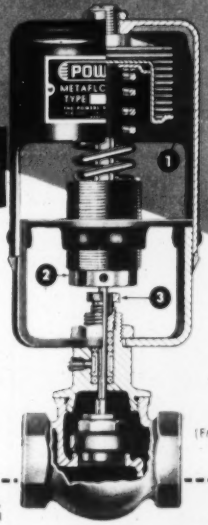

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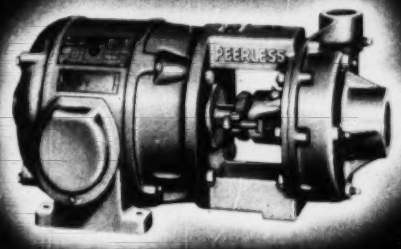
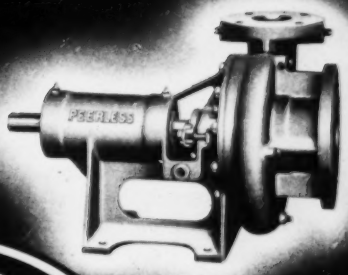


Type PE MOTOR SIZE: 1-40 H.P.
CAPACITY: Up to 5500 gpm
HEADS: Up to 270 Feet

BELTED OR DIRECT-CONNECTED
TYPE *Integral H. P.*



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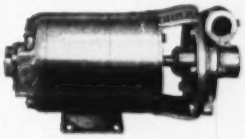

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Capacity: To 50 gpm • Heads: To 90 Ft.

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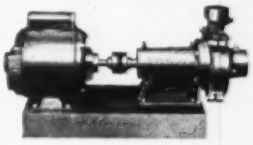

¼ to 1 h.p. • 3450 rpm • 60 cycle
Capacity: To 50 gpm • Heads: To 90 Ft.

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- Complete concealment behind standard perforated acoustical ceiling pans.

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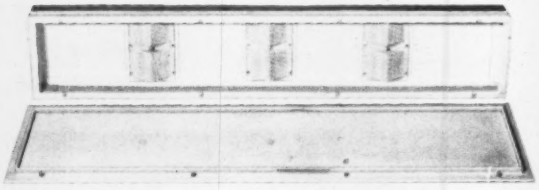

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For long narrow peripheral zoning.

For economical installation in standard suspended ceilings.

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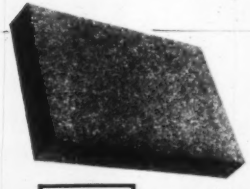

This is FOAMGLAS®

The entire strong, rigid block is composed of millions of sealed glass bubbles. They form a continuous structure which has unusually high resistance to moisture, vapor and acid atmospheres, is noncombustible, verminproof and odorless. In those closed glass cells, which contain still air, lies the secret of the material's long life insulating efficiency.

Pittsburgh Corning Corporation
Dept. RR-50, 307 Fourth Avenue
Pittsburgh 22, Pa.

Without obligation on my part, please send me your FREE booklet on PC Foamglas Insulation for:

Piping & Equipment ☐ Refrigerated Structures ☐ Commercial & Industrial Buildings ☐
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Name _____

Address _____

City _____ State _____

PITTSBURGH PC CORNING

® FOAMGLAS INSULATION

. . . when you insulate with FOAMGLAS . . . the insulation lasts!

A LITTLE ROUTINE SERVICE SAVED A LOT OF BRAZING ALLOY

In this oil burner nozzle lead, EASY-FLO 45 joins a steel tube and a copper tube to the brass forging at left. Steel tube is inside the copper tube. Both joints are induction brazed simultaneously, two assemblies at a time in 38 seconds.

It has always been our aim to help *every* user of our EASY-FLO and SIL-FOS alloys get the fullest benefit of the speed and low cost these low-temperature silver brazing alloys bring to metal joining. So, follow up is routine—and very often our men are able to come up with constructive suggestions.

For example—a user was brazing a small steel tube and a larger copper tube to a brass forging to make the oil burner part shown. He was using two rings of 1/16" EASY-FLO 45 wire, one for each joint—and he was perfectly happy with results.

Looking in on the job our man felt that more alloy was being used than was needed. So he got some of the parts and sent them back to our research lab. There it was found that rings of 1/32" and 3/64" wire for the steel and copper tubes respectively, were ample. Naturally, the change was made—and the saving in cost from this little reduction in the size of alloy wire has mounted to sizable proportions.

CAN YOUR BRAZING COSTS BE CUT?

Whether or not you are now using EASY-FLO and SIL-FOS alloys, we'll be glad to send a field engineer to give you the answer—without obligating you in any way. Just write or call and say when.

For the facts about these alloys in print, write today for Bulletins 12-A and 15.

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FOUNDED 1867
QUALITY SERVICE

HANDY & HARMAN

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Agents in Principal Cities

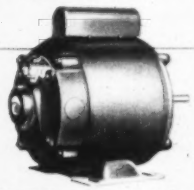
Century 1/8 TO 3/4 H. P. MOTORS

Choose From These Many Types to Fit Your Job

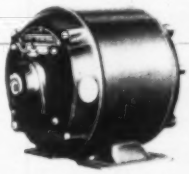
HEAVY-DUTY for Industrial and Appliance Use

From Century's wide range of types and sizes, there's a proper motor for all popular applications. You can be confident that the right Century motor will assure a long life of satisfactory performance.

Shown here are examples of Century's line of FRACTIONAL HORSEPOWER motors—ruggedly built for smooth, quiet operation, with a remarkable freedom from vibration



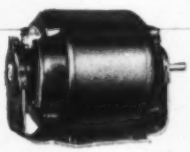
TYPE CSH — Capacitor Start Induction Single Phase Motor suitable where high starting torque and normal starting current is satisfactory.



TYPE SP — Split Phase Induction, Rigid Base, Single Phase Motors suitable for light starting duty.

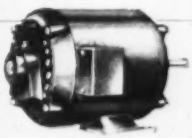
TYPE SC — Squirrel Cage Polyphase Motor built in fractional sizes for all torque requirements.

JET PUMP MOTOR — Capacitor Start Single Phase Motor available in sizes for practically every jet pump application.

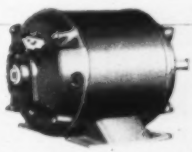


TYPE SP — Split Phase Induction, Cushion Base, for quiet operation.

OIL BURNER MOTOR especially designed for this service. Compact, rugged, smooth, quiet starting and running.

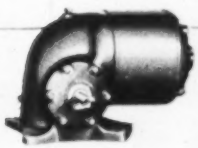


TYPE RS — Repulsion Start Induction Single Phase Brush Lifting Motor suitable for applications requiring high starting torque and low starting current.



TYPE DM — Direct Current built in sizes and ratings for applications where direct current is available or its use desirable.

UNIT HEATER MOTOR provides smooth, quiet performance throughout a long service life.



GEAR MOTOR, compact, rugged, ball bearing equipped, for your high torque, slow speed requirements.

The complete line of Century motors includes a wide range of types and kinds, from 1/8 to 400 horsepower. They are available in open rated, splash proof, totally enclosed fan cooled and explosion proof frames.

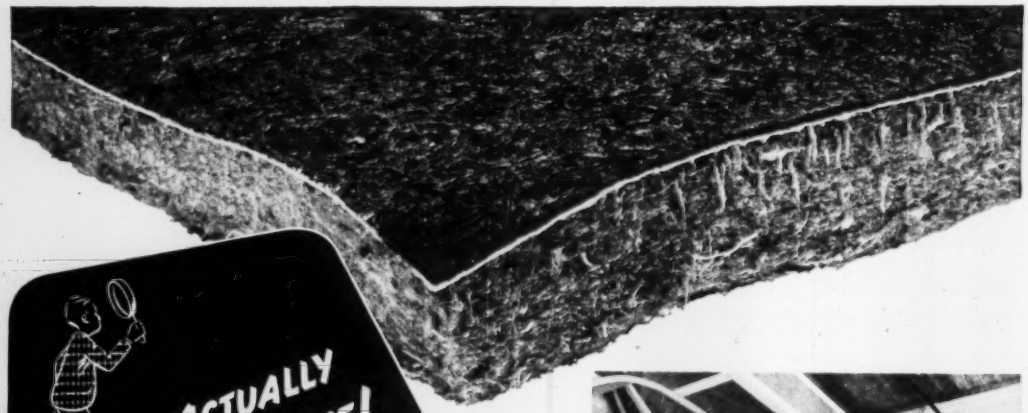
Specify Century motors for all your electric power requirements.

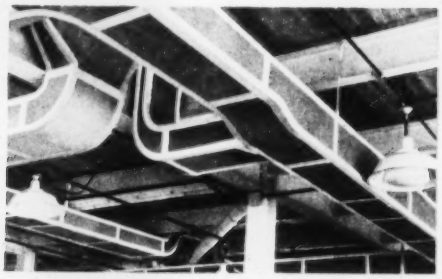
CENTURY ELECTRIC CO.
1806 Pine Street
St. Louis 3, Missouri

682

OFFICES AND STOCK POINTS IN PRINCIPAL CITIES

Grant Wilson DUX-SULATION



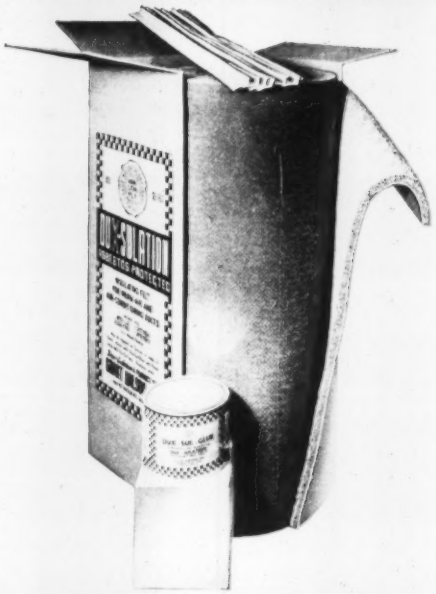


HERE'S WHY:

Unlike other insulating material, Dux-Sulation is engineered specifically for duct work—not "adapted" to it. Not just "insulation", Dux-Sulation is a complete *system*—is supplied with the correct adhesive (Dux-Sul-Glue) and special tape to finish off edges and seams—needs no external covering or extra fastenings to hold it in place or to protect it—contains an integral asbestos membrane for tamper-proof safety.

Dux-Sulation *invites* proper installation because the *correct* way is the *easy* way. Because of its durability, Dux-Sulation can be applied to ducts and fittings *right in the shop*, without fear of damage in transit or erection. Dux-Sulation is stable and permanent; it cannot crumble, disintegrate into powder or rot away—is not subject to extreme and irregular compression in fastening nor does it become loose. This means that the Architect, Engineer and Contractor can depend upon Dux-Sulation's efficiency as a *constant* factor rather than a diminishing one—can depend upon Dux-Sulation being properly installed—can depend upon "no call-backs" after the job is finished.

These are just a few of the *reasons* (not theories) why Dux-Sulation DOES THE JOB BETTER—why, like most top-quality products, Dux-Sulation gives *more* value instead of less—why it's cheaper to *use!*



Grant Wilson inc.

ASBESTOS and INSULATING MATERIALS

Write Grant Wilson, Inc., 141 W. Jackson Blvd., Chicago 4, Ill., for complete facts and prices. Ask for bulletin #408-H.

IN NEW YORK CITY: Air Conditioning Corp., 50 W. 50th St., N. Y. 19, N. Y. Circle 7-2360 IN CANADA: Atlas Asbestos Co. Ltd., Montreal, Toronto, Winnipeg, Vancouver

"We Heard You Talking"

We have kept note of all the features you have wanted in the "perfect" air filter for forced warm air furnaces and unit air conditioners. Here's the R-P answer . . . E-Z KLEEN AIR FILTER! It's very *easy* to wash; made of alūmaloy for lightness, rust resistance, long-life and attractiveness; enclosed in sturdy aluminum frame with strong wire grid; and offered at *extremely low prices* from $1.55 up!

E-Z KLEEN was first shown at the Texas show where it won enthusiastic acceptance, immediate orders. Now in volume production, it is available for prompt delivery. Write Research Products Corp., Madison 10, Wisconsin, Dept. H. Canadian Representative—Delhi Industries, Delhi, Ontario.

NOW IN VOLUME PRODUCTION

Write for technical Data Sheet on sizes, capacities, and low prices!

RP . . . PRODUCTS OF RESEARCH

WASHABLE AND REPLACEMENT AIR FILTERS • GREASE FILTERS • EVAPORATIVE COOLER MATERIALS

TO DO A BETTER PIPING JOB...

USE GLOBE
PRECISION PROCESS SEAMLESS WELDING FITTINGS

Your preference for Globe Welding Fittings is supported by a source of supply with exceptional qualifications. Specialized metallurgical experience and facilities gained in years of steel tubing manufacture enable Globe to produce welding fittings by a precision process that yields a superior product.

Send for the Globe Welding Fittings Catalog No. 501.

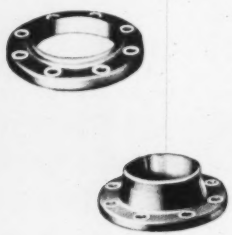
GLOBE STEEL TUBES CO., Milwaukee 15, Wisconsin

Chicago — Cleveland — Detroit — New York — Philadelphia — St. Louis — Tulsa — Houston — Denver — San Francisco — Glendale, Calif.

SIZE RANGE OF GLOBE SEAMLESS WELDING FITTINGS

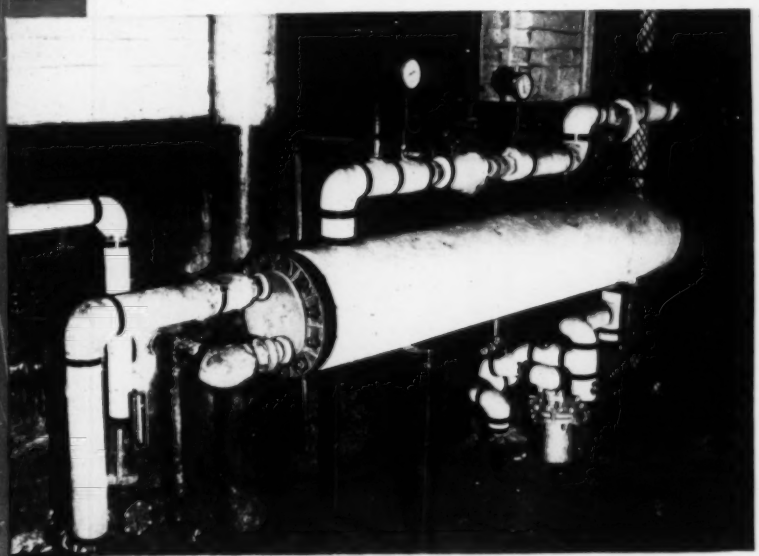
Description of Fitting	Standard Weight (Schedule 40)	Extra Strong (Schedule 80)	(Schedule 160)	Double Extra Strong
Elbows 45° Long Radius	½ in. to 24 in.	½ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Long Radius	½ in. to 24 in.	½ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Returns 180° Long Radius	½ in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	3 in. to 8 in.
Returns 180° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Reducers (Concentric and Eccentric)	1 x ⅛ in. to 24 x 20 in.	1 x ⅜ in. to 24 x 20 in.	1 x ⅜ in. to 12 x 10 in.	1 x ⅜ in. to 12 x 10 in.
Tees Straight	⅛ in. to 24 in.	⅛ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Tees Reducing Outlet	⅛ in. to 24 in.	⅛ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Stub Ends Lap Joint	1 in. to 24 in.	1 in. to 24 in.	- - -	- - -
Caps	1 in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.

Flanges available 1 inch to 24 inches in all weights



Producers of Globe Seamless Stainless Steel Tubes —Gloweld Welded Stainless Steel Tubes—Carbon — Alloy — Seamless Steel Tubes — Globeiron Seamless High Purity Ingot Iron Tubes and Pipe.

SIMPLEST WAY TO ADD AN
extra source of hot water



The General #629 Instantaneous Water Heater shown here serves 9 Bradley 54" wash fountains. It provides 36 gallons of water a minute raised from 40° to 140° with steam at 5 lbs. pressure. Located 400 ft. from main boiler room.

SAVES MONEY

SAVES SPACE

SAVES FUEL

IF YOUR PRESENT HOT WATER SYSTEM isn't large enough to meet requirements of new wash rooms or new processes, consider the unique advantages of General Instantaneous Water Heaters. These compact, efficient units can be strategically spotted throughout your plant. They save money because they have no tank to install . . . require no excavating, no complicated piping. Save space . . . the largest of 17 sizes measures less than 15" by 120". Save fuel because they avoid long piping runs and heat waste.

The General Instantaneous Water Heater supplies up to 270 gallons of hot water a minute. Heated with live steam up to 125 lbs. through the shell . . . or with exhaust steam or boiler water. or boiler water.

Here's the economical, efficient way to boost hot water capacity without crowding any more equipment into your boiler room. Send for Catalog 18 today. General Fittings Co., Dept. A, 123 Georgia Ave., Providence 5, R. I.

GENERAL INSTANTANEOUS WATER HEATERS
17 SIZES UP TO 270 G.P.M.

GENERAL

TANKLESS AND INDIRECT
WATER HEATERS AND HEATING SPECIALTIES

THE NEW EQUITABLE SAVINGS AND LOAN ASSOCIATION BUILDING
IN PORTLAND, OREGON

Weather-conditioned with the nation's largest

HEAT PUMP

Equipped throughout for lasting efficiency with

JENKINS VALVES

Owner:
EQUITABLE SAVINGS & LOAN ASSOCIATION

Architect:
PIETRO BELLUSCHI

General Contractor:
ROSS B. HAMMOND CO.

Consulting Engineer:
J. DONALD KROEKER

Mechanical Contractor:
P. S. LORD

Air Conditioning System:
THE TRANE CO.

The new Equitable Building in Portland, Oregon, presents an impressive array of "firsts" in ultra-modern construction.

Most notable innovation is the reverse cycle refrigeration—the intriguing new "Heat Pump"—for all-year air conditioning. This superbly engineered system either heats or cools the building, as needed, and in certain seasons, provides heating in some zones, and cooling with humidification in others, both at the same time.

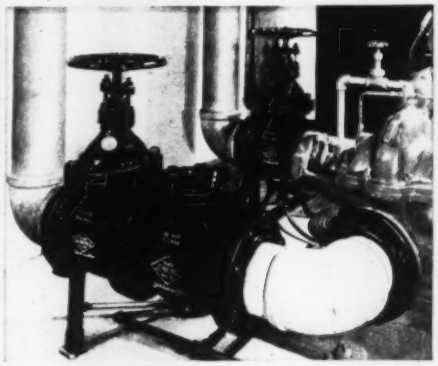
To be economically practical, this highly flexible system must operate with unfaltering efficiency. Every component was selected for dependable performance and exceptional durability.

The choice of Jenkins Valves, 582 in all, for all pump and convector lines, and for general pipelines as well, is significant. It is further proof that leading architects, engineers, and contractors rely on Jenkins whenever the installation must meet the highest standards of efficiency and economy.

Despite their extra value, *you pay no more* for Jenkins Valves. For new installations, for all replacements, let the Jenkins Diamond be your guide to lasting economy.

Sold through leading Distributors everywhere.

Jenkins Bros., 100 Park Ave., New York 17.
Jenkins Bros., Ltd., Montreal.



JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864 TRADE JENKINS MARK

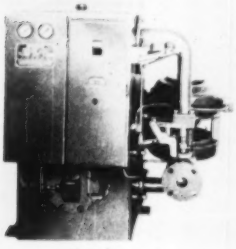
Jenkins Bros

EQUIPMENT DEVELOPMENTS...

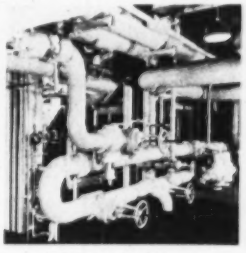
For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1950 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk, equipment and manufacturer not listed.

HPAC 1—VACUUM PUMP—A newly designed model C vacuum pump has been developed by C. A. Dunham Co., 400 W. Madison St., Chicago 6.

Manufactured as a single or duplex unit for capacities of 2500 to 20,000 EDR, the pump is said to be extremely compact. The centrifugal pump and the electric motors are mounted on the side of the vacuum pump, well above the floor level. This, says the company, not only saves floor space but gives increased protection from surface water and splash of floor cleaning operations. The company also states that the pump does not require a separate accumulator tank on the average installation. Inlet connections are at a low level, enabling the accumulator tank to be built into the air separating tank. This feature is said to eliminate, in many cases, the necessity of pitting the pump.



Vacuum Pump



Thermal Insulation

HPAC 2*—CALCIUM SILICATE THERMAL INSULATION—Originally developed in Europe using calcium oxide or hydroxide and sand, calcium hydro silicate is now being used with asbestos fibers in the manufacture of a new high temperature molded thermal insulation.

The density is 10 to 15 lb per cu ft and the thermal conductivity is approximately 0.33 Btu at a mean temperature of 100 F and 0.71 Btu at a mean temperature of 1000 F. It is said to withstand a soaking heat of 1250 F and to be insoluble in water. It can be applied on pipe lines and equipment in either single or double layers and no other insulation is needed as a protective inner layer. The material is said to be easily cut and harmless to the hands. Calcium silicate dust is said to be nontoxic.

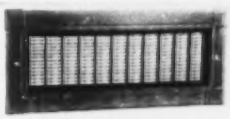
This type of insulation is available from a number of manufacturers, including Eagle-Picher Co., American Bldg., Cincinnati 1; Kaylo Div., Owens-Illinois Glass Co., Box 1035, Toledo 1; and Ruberoid Co., 500 Fifth Ave., New York.

HPAC 3*—INDUCED DRAFT COOLING TOWERS—High heat transfer efficiency, ruggedness, accessibility of all parts, weatherproof construction, and hot dip galvanizing of steel parts are said to be some of the features incorporated in the new line of induced draft cooling towers offered by United States Air Conditioning Corp., 33rd & Como Ave., S. E., Minneapolis 14.

Opposed separate banks of spray nozzles at the top and bottom of the spray section are designed to provide relatively long water travel and intimate water-air contact. Nozzles are of brass, are designed to spray without misting, and are of nonclog design. The blower motor is mounted on the exterior of the unit, to simplify belt adjustment and speed changing, and the spray section is welded to a base of 3 in. channel iron. Each of the other sections is of all-welded construction. A variety of pumps is offered to handle different pressure heads.

Units are available in sizes for use with 3, 5, 7½, and 10 ton refrigeration condensers.

HPAC 4—AIR SUPPLY GRILLE—Designed for ventilating or air conditioning systems, the new "Uni-Flo" fixed fin model EF supply grille is now available from Barber-Colman Co., Rockford, Ill.



Diffusion fins are used to impart a turbulent action to the supply air in order to minimize drafts and to produce rapid temperature equalization. According to the manufacturer, the grilles have a large free area for low noise level and a minimum pressure drop. For ease

(Continued on page 174)

FOR YOUR CONVENIENCE [8-50]

Heating, Piping & Air Conditioning
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each HPAC number in which you are interested)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31*	32	33	34	35	36	37	38	39	40
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132								

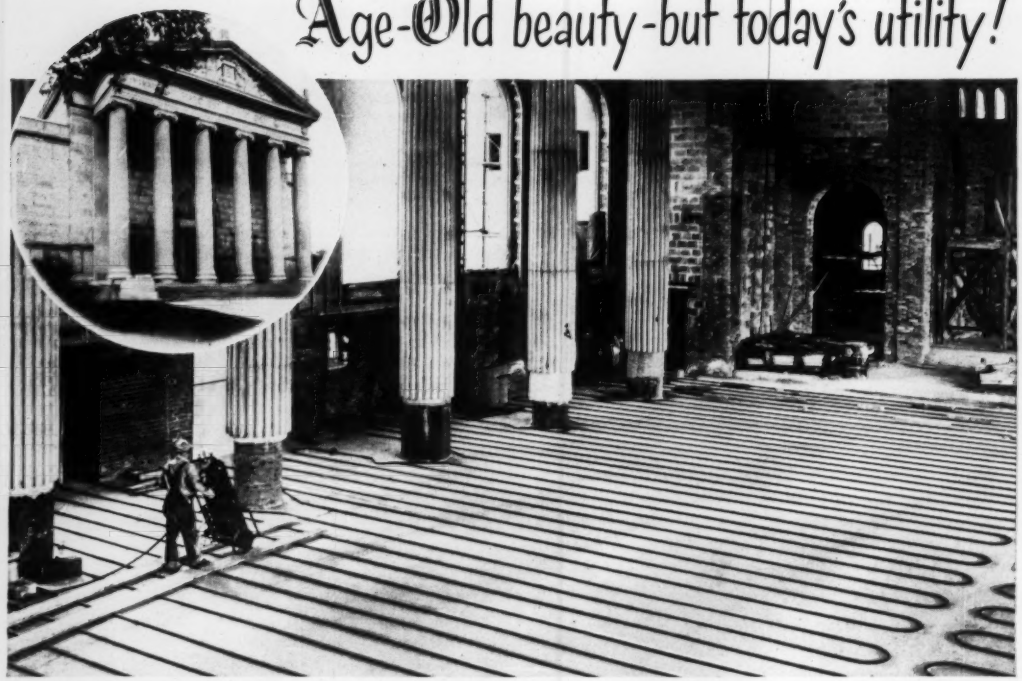
Name ..... Title .....

Company .....

Address .....

City ..... Zone .... State .....

Age-Old beauty-but today's utility!



For radiant heated churches, steel pipe is first choice

The inspiration of religion upon the lives of men has been reflected down the centuries, in the beauty and perfection of our houses of worship. Be it a cathedral or a "little brown church in the vale" the traditions of architectural purity have been carried on by succeeding generations.

In the preservation of this age-old beauty, even concessions to the use of modern conveniences and facilities can be harmoniously achieved. Among heating systems, for example, none is more adaptable for this purpose than modern *radiant* heating. Comfortable warmth from concealed sources helps to maintain the simple, dignified atmosphere. Large areas can be heated uniformly. Decorating and cleaning costs are minimized.

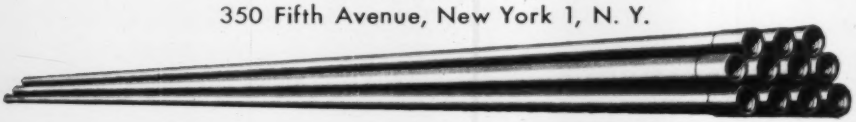
Just as radiant heating blends comfort with beauty, so steel pipe blends durability with economy. That's why steel pipe is first choice for radiant systems in churches, public buildings, plants and warehouses as well as homes. It is natural that it should be so. For more than 60 years steel pipe has a record of proved performance in conventional steam and hot water heating systems.

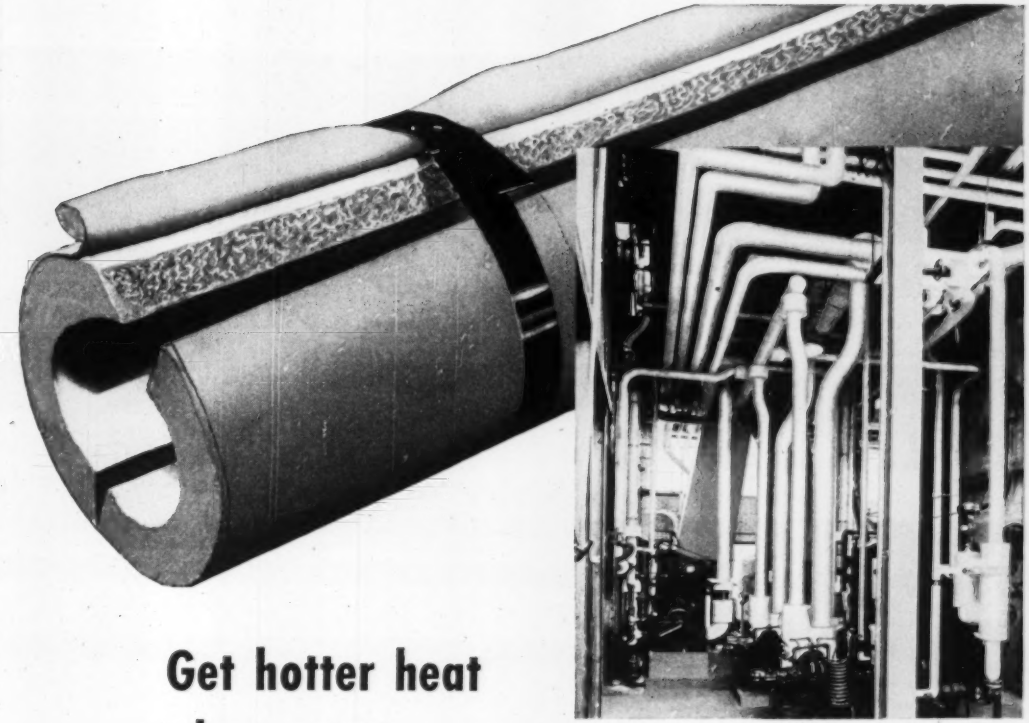
Partial view of side and bell tower, while under construction, of St. Ann's Church, Cleveland, O. Radiant heating, with steel pipe will provide complete comfort without marring interior beauty.

COMMITTEE ON STEEL PIPE RESEARCH

AMERICAN IRON AND STEEL INSTITUTE

350 Fifth Avenue, New York 1, N. Y.





Steam piping, covered with K&M "Featherweight" 85% Magnesia, in Standard and 1½" thicknesses; canvas covered.

Get hotter heat at less cost with K&M "FEATHERWEIGHT"® insulation

Keep heating costs down—and heating efficiency up—with K&M "Featherweight" 85% Magnesia Insulation. 85% Magnesia is the most widely accepted insulating material in its field. And in K&M "Featherweight," basic carbonate of magnesia is combined with selected and specially processed asbestos fibers to produce a highly efficient insulation of extremely low thermal conductivity.

K&M "Featherweight" withstands temperatures up to 600° F. without loss of insulating value. And, though it's amazingly light in weight, it is strong and durable also. It can withstand vibration, a reasonable amount of compression, and its insulating properties are not affected by alternate wetting and drying. As it is entirely mineral by nature, it cannot burn.

"Featherweight" 85% Magnesia insulation is easy—and economical—to apply. It can be stored and handled without any special precautions. No special tools are needed to apply it: "Featherweight" is easily sawed and cut; can be fitted snugly to contours without breaking apart.

K&M "Featherweight" 85% Magnesia is furnished for all standard pipe sizes in sections and in sets of segments 3 feet long in the following thicknesses: Standard, 1½", 2", double standard (broken joint) and 3" (broken joint). Blocks and lagging are also available for irregular surfaces. Ask your K&M Distributor for complete information, or write us direct.

K&M best in asbestos ®

Nature made Asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

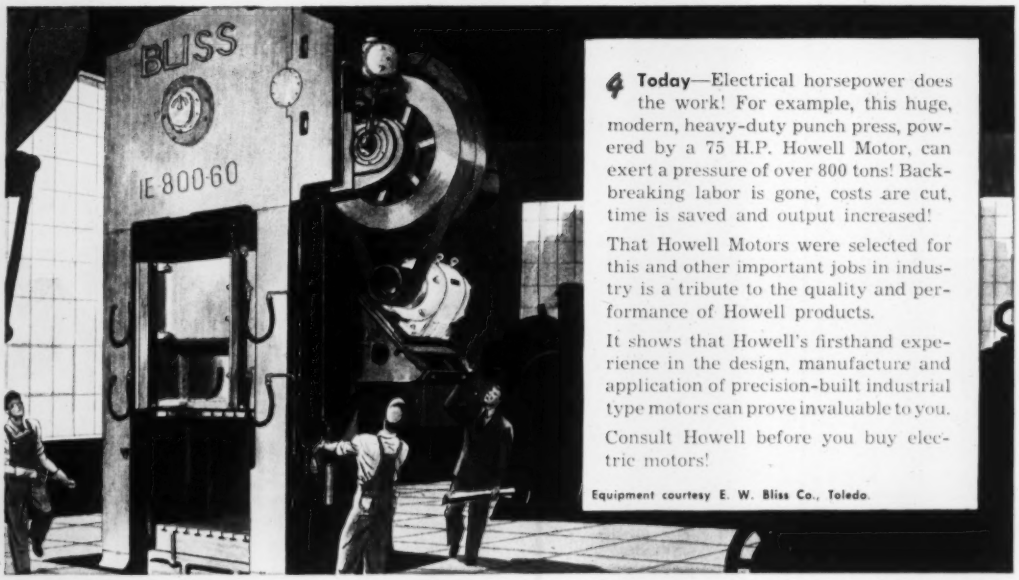
KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

1 **1600**—Man worked hard for his pay in these days. Crude machines like this began to lighten his load by replacing laborious handwork with foot power. But progress was really only beginning.

2 **1875**—By accident, it was discovered that if two direct current dynamos were connected together, one would serve as a generator and drive the other as a motor. Electrical horsepower was here!

3 **1900**—Result: Electrical horsepower replaced foot power! By 1915, Howell "Red Band" Electric Motors arrived. Soon, these rugged, industrial type motors were widely accepted in many industries.

NOW...A PUNCH PRESS WITH A PUNCH!



4 **Today**—Electrical horsepower does the work! For example, this huge, modern, heavy-duty punch press, powered by a 75 H.P. Howell Motor, can exert a pressure of over 800 tons! Back-breaking labor is gone, costs are cut, time is saved and output increased!

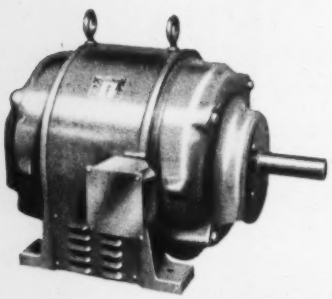
That Howell Motors were selected for this and other important jobs in industry is a tribute to the quality and performance of Howell products.

It shows that Howell's firsthand experience in the design, manufacture and application of precision-built industrial type motors can prove invaluable to you.

Consult Howell before you buy electric motors!

Equipment courtesy E. W. Bliss Co., Toledo.

Free enterprise encourages mass production, supplies more jobs—provides more goods for more people at less cost.



Howell Type F Punch Press Motor

HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Precision-built Industrial Motors Since 1915

HOWELL Red Band MOTORS

"If you are going to maintain private enterprise . . .

HONORABLE PAUL G. HOFFMAN
Administrator,
Economic Co-operation Administration

"If you are going to maintain private enterprise in the United States, you must have private savings. There is no substitute for them. If America ever loses the habit of thrift, and stops saving, the funds for private enterprise will cease."

More than 8,000,000 Americans . . . in 21,000 companies are enjoying the habit of thrift. By systematic purchase of U. S. Savings Bonds through the Payroll Savings Plan they are building their independence . . . creating a fund for the education of their children . . . putting aside money for a home or working towards other objectives that contribute to our national economy and the preservation of private enterprise.

Employes are not the only beneficiaries of the Payroll Savings Plan. As employee participation in the plan increases, absenteeism and turnover go down and production goes up, because bond buyers are steadier, more careful workers. That is not theory—it is the experience of companies that get behind the Payroll Savings Plan.

There's a national benefit, too. Think of the backlog of purchasing power being built up, month after month, by more than 8,000,000 workers!

If you are not affording your employes an opportunity to build a future for themselves, their company and their country through participation in the Payroll Savings Plan, get in touch with your State Director, U. S. Treasury Department, Savings Bond Division. He will be glad to provide application cards, promotional material and as much personal help as you need to install and build up your Payroll Savings Plan.

The U. S. Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the G. M. Basford Company and

HEATING, PIPING & AIR CONDITIONING

{Continued from page 169}

in installation, the frames are drilled for mounting screws. Units are available in a wide range of sizes and in a gray prime coat or electroplated metal finishes to harmonize with virtually any decoration.

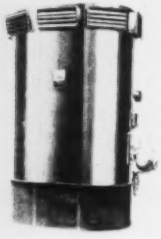
HPAC 5—CONTROL VALVE—Powers Regulator Co., 2759 A Greenview Ave., Chicago 14, is offering a new diaphragm operated, "Flowrite" control valve for regulating the flow of steam, water, oil, or gases. Operated by either air or water, it is designed for pressures below 250 psi and is available in sizes from ¼ in. through 8 in.

The molded neoprene diaphragm (1 in the illustration) has a sealing bead which is said to provide increased sealing action with increased control pressure. The piston plate assembly (2 in the illustration) has a free floating thrust plate designed to absorb side thrust and the piston plate is said to be closely guided to maintain the stem in accurate alignment. The adjusting screw is of the ball bearing, nonrising type and is said to be easily accessible. The valve stem is of polished stainless steel and the metallic packing is preformed and lubricated.

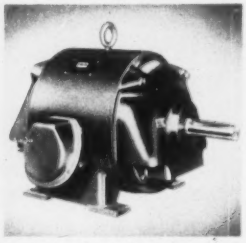
Direct, reverse acting, and three way valves of the single or doubled seated type are available with double unions and flange ends. The valve trim may be of stainless steel or bronze.

HPAC 6—DIRECT FIRED AIR HEATER—Now in production at the plant of Prat-Daniel Corp., East Port Chester, Conn., is the model 1000 "Thermobloc," delivering 1,000,000 Btu per hr. and occupying a floor area of approximately 44 in. by 70 in.

Completely automatic in operation and said to have an efficiency of from 82 to 86 percent, this direct fired air heater has a number of louvered outlets around the top. These are designed to provide an even 360 deg distribution of low velocity heated air. An advantage stressed by the company is the discharge of air at "the working level." The unit may also be used for summer ventilation.



Air Heater



Splashproof Motor

HPAC 7—SPLASHPROOF MOTORS—The new splashproof, type CSP "Life-Line" induction motors of Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, are squirrel cage motors designed for constant speed application, both indoors and outdoors.

Units are protected from dripping or splashing liquids by solid rolled steel frames and baffles in the end brack-

STAINLESS STEEL

WHICH ALLOY FOR YOUR PIPING JOB?

Industry is rapidly turning to stainless steels as standard material for an increasing number of piping applications. Their ability to withstand the action of many corrosive agents, their toughness in sub-zero applications, their strength and ductility in elevated temperatures, and their high scaling-resistant properties, answer many tough piping problems.

Recent surveys show that 95% of the demand for stainless steel piping is in these three types:

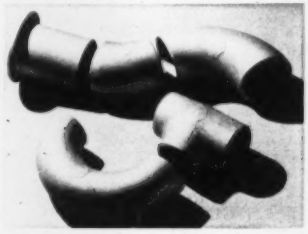
Type 304—18% chromium, 8% nickel
Type 347—18% chromium, 8% nickel, 1% Columbium
Type 316—18% chromium, 8% nickel, 2% Molybdenum

Each exhibits inherent qualities that make it ideal for certain applications. Thus, while the group as a whole covers 95% of industry's needs, individual applications should be studied carefully to determine which grade is best for the job.

For example, a prominent soap manufacturer's requirements are 10% Type 304, to eliminate product contamination—45% Type 347, to carry low temperature organic acids—and 45% Type 316, to carry the same acids at elevated temperatures.

In the food and dairy industry, where the service is only mildly corrosive, the main reason for using stainless steel is to promote cleanliness and to eliminate contamination. Type 304 satisfies most of the demand here.

To provide the greater strength, greater safety and permanently leakproof joints of welded piping construction, Tube Turns, Inc. has developed a wide selection of types and sizes of welded fittings and flanges in all three grades of stainless steels listed above. It's the most complete line available today.



TUBE-TURN Stainless Steel Welding Fittings made of the three alloy types listed here, are available in a wide range of parts and sizes, including elbows, returns, tees, reducers, caps, lap joint stub ends, laterals and crosses. Flanges are also furnished.

NEW CATALOG

Write today for your free copy of the new Stainless Steel catalog, just published by Tube Turns, Inc. It contains the complete description of TUBE-TURN Stainless Steel Welding Fittings and Flanges, as well as valuable information on the use of stainless steel piping.

"Be Sure You See The Double tt"

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

In all the world there's only one TUBE-TURN Welding Fitting as shown by this trade mark... the right mark for every need in welding fittings and flanges.

TUBE-TURN
TRADE MARK

Your nearby TUBE TURNS distributor can serve you right from stock. Call him for prompt delivery.

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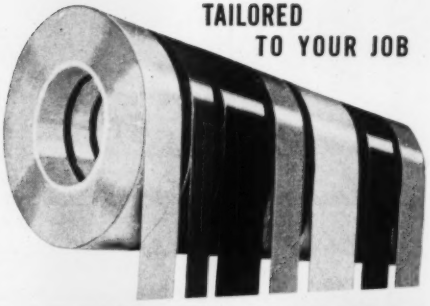
THE NEW

Polyken®

INDUSTRIAL TAPES

TAILORED TO YOUR JOB



Now wrap buried pipe only once—for good! This buried pipe is hand-wrapped in a few seconds with *Polyken* No. 882. The polyethylene tape is especially oriented to s-t-r-e-t-c-h. Provides a lasting compression against the pipe. Sticks tight to irregular surfaces. And it's *permanent!*

The first permanent anti-corrosion coating for pipes

Now you can protect pipes against corrosion for good . . . *in* minutes! No need for heat, flame, solvents, or greases. Just wrap this new plastic tape (polyethylene) around pipes once and forget about corrosion. Resists moisture, soil bacteria, solvents, and has a dielectric strength of over 10,000 volts.

Use jet black *Polyken* No. 882 for underground installations—aluminum-colored *Polyken* No. 888 on above-surface pipe lines. For coating underground pipe, corrosive hot spots, above-ground installations on cooling towers, evaporators and piping exposed to corrosive atmosphere . . . these *Polyken* tapes save time, money, and *—pipe!* See your *Polyken* distributor.

FREE SAMPLES. Write now for free engineering and application data, plus samples, of *Polyken* Nos. 882 and 888. Address *Polyken*, Dept. HP-1, 222 W. Adams St., Chicago 6, Illinois.

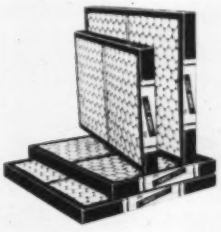
Polyken Industrial Tape, Department of Bauer & Black, Division of The Kendall Company

ets, and motors are equipped with prelubricated bearings. Typical applications are said to include food processing plants, chemical plants, boiler rooms, laundries, oil fields, refineries, and similar places where splashing liquids are frequently encountered.

Motors are available in various sizes from 7½ to 100 hp, for 60, 50, or 25 cycle current, and for 208, 220, 440, 550, or 2300 volts.

HPAC 8—REPLACEABLE AIR FILTER—A new replaceable type air filter, the "Amer-Glas," made in all standard sizes for forced air heating, ventilating, and air conditioning systems, has been introduced by American Air Filter Co., Inc., Louisville 8, Ky.

The filtering medium consists of continuous strands of glass filaments held together at each point of contact by a high temperature plastic bond to form a resilient pad. The pad is sprayed with an odorless and nonflammable adhesive and placed in a fiber board casing between metal grilles.



Testing Ventilation in Clothing

Left: Air Filters

HPAC 9—AIR METER—The air "Ventimeter," a new instrument for measuring ventilation air flow utilizing a miniature nondirectional probe, is available from Hastings Instrument Co., Inc., Hampton, Va.

The device consists of an indicator for reading velocities from 5 to 6000 fpm and a nondirectional pick-up element ⅜ in. long and ¼ in. in diameter. The indicator and probe operate on the noble metal thermopile principle. According to the manufacturer, the device was recently developed for the Army Quartermaster Corps to study ventilation between layers of clothing and has now been adapted for general commercial applications.

It is said to be ideally suited for microclimatology studies, for use in the control of ventilation during painting, finishing and drying processes, cooling and air flow studies in motor and machinery design, air flow measurements within small ducts and grilles, and similar applications. It is said to be of particular value for measurements where the amount of cooling or ventilation must be determined in confined areas and where the direction of flow is unknown or variable.

In the accompanying illustration, the device is being used to measure ventilation between layers of clothing.

HPAC 10—COMMERCIAL, OUTSIDE THERMOSTAT—A new low cost thermostat consisting only of a coil of wire and designed for installation outside of buildings is offered by Minneapolis-Honeywell Regulator Co., 2604 Fourth Ave., S., Minneapolis 8.

The electronic control was developed for small office and apartment buildings, stores, warehouses and similar structures where it is difficult to locate an inside thermo-

Now ready for you

the new

INDEPENDENT REGISTER AND GRILLE CATALOG No. 50

This new catalog—just off the presses—contains 36 pages. The catalog provides selection tables, weights, open areas, sizes and prices of the complete Independent Register line of grilles, cold air faces, registers, and ceiling outlets—both "Fabrikated" and wrought steel.

Your copy will be mailed to you promptly if you request it on your business letterhead.

Always Leading
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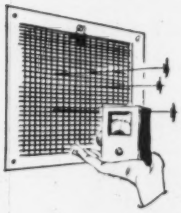
Always Progressing

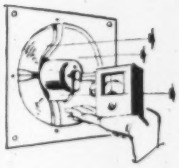
MEMBER
INDOOR COMFORT

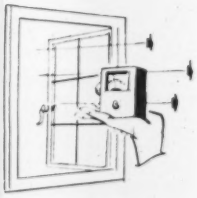
THE INDEPENDENT REGISTER CO.
3747 E. 93rd STREET · CLEVELAND, OHIO

Fastest



Surest way to check Air velocities





Handsome Genuine Leather Case
Available for Only $6.00

Only $33.00
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Velometer Jr.

FOR BALANCING AIR SUPPLY
IN NEW OR EXISTING SYSTEMS

Here's the way to take the guesswork out of the job of balancing systems and to speed up the adjustment of any air conditioning, heating, and/or ventilating set-up. It's the Alnor Velometer Jr., the miniature, direct-reading air-velocity meter—a handy low-cost instrument for instantaneous and precise measurement of air velocities in unrestricted areas. Only 4 inches high, 3 inches wide, 1½ inches deep, Velometer Jr. is precisely built for accurate performance—with double pivoted, double jeweled movement, air-actuated pointer vane, and sturdy, handsome, molded bakelite case. Available with single or double velocity range scales, Velometer Jr. can be one of your most useful tools for years to come.

NOW IS THE TIME . . .
Order your Velometer Jr. today while you are thinking about it. And send for Bulletin which gives complete details. Use the handy coupon!

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Enclosed find check for $.....to cover purchase of.....
Velometer Jr. and.....carrying case.

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Alnor

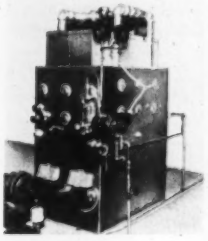
PRECISION INSTRUMENTS FOR EVERY INDUSTRY

stat in a representative position to regulate the heating of the building. Called "Cyclotrol," the system regulates inside temperatures by measuring the temperature outdoors. According to the company, the thermostat determines from temperature the percentage of time the heating plant should operate to maintain desired temperatures inside. The wire used changes its electrical resistance in accordance with temperature and this change is picked up and measured by an electronic amplifier.

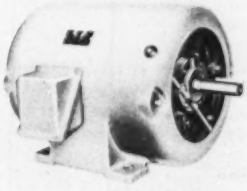
The thermostat can be used with any type of heating system burning any kind of fuel and may be used to automatically reduce temperature at night and raise it again in the morning.

HPAC 11—STEAM BOILERS**—Consolidated Boiler Corp., 126 Dartmouth St., Boston 16, has developed a line of steam boilers for industrial process and heating applications. Units are furnished, at present, in sizes of approximately 15 and 30 hp. Plans are under way for the production of a 60 hp unit.

According to the manufacturer, the outstanding feature of these boilers is that three types of steam can be furnished. Operating at 15 psi, units may be used to provide saturated steam with temperatures as high as 220 to 290 F, steam with some saturation and temperatures as high as 280 to 400 F, or a dry steam with temperatures as high as 390 to 550 F. Boilers are completely automatic and the manufacturer guarantees a 70 to 90 percent recovery at all times.



Steam Boiler



Cast Iron Frame Motor

HPAC 12—CAST IRON FRAME MOTORS—Available in ratings of 5 hp through 250 hp and in both standard and explosionproof designs, a new line of cast iron frame, totally enclosed fan cooled motors is offered by Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14.

Units are said to be especially suitable for applications in chemical plants, oil fields, petroleum refineries and similar industrial plants where corrosion is a problem, either because of the nature of the materials processed or because the motors must be installed outdoors.

Features are said to include the use of cast iron for the frame, end plates, blower shield, and conduit box. The blower on the standard motor is of malleable iron, and on the explosion proof motor, bronze is used. Other features are said to include sealed leads, cartridge type ball bearings, completely protected lamination, a special varnish treatment of the windings and the use of a cast aluminum rotor.

HPAC 13—PERFORATED PANEL DIFFUSER—The Multi-Vent Div., Pyle National Co., 1334 N. Kostner Ave., Chicago 51, has introduced a new 1 ft wide "Multi-Vent"

Prevent Expensive Repairs and Avoid Shutdowns

Stop trouble before it starts.
Install ADSCO Strainers and Separators... keep operating equipment running at top efficiency

ADSCO Y and T-Type STRAINERS keep dirt and scale out of your equipment. Installed ahead of every regulator, pump, valve or trap, ADSCO Strainers will reduce maintenance and prevent costly shutdowns. Designed with tapered seating of screen and gasketed cap. Pressure drop no greater than through ordinary elbow. Sizes from ¼" to 6". For 9 to 1 screen ratio, and extra large pocket for sediment collection, use the ADSCO T-Type.

ADSCO SUCTION STRAINERS are used on lines carrying oil, water or other liquid. Usually installed on the suction side of pumps and other apparatus, they can be used on discharge or other service. Solids collect in large basket screen, easily removed for cleaning. Quick opening cover. Straight through or offset connections in sizes from 2" to 10", for various pressures up to 300 psi.

ADSCO SEPARATORS remove moisture, oil and small solid matter from steam, air and gas lines. Deliver dry steam to equipment for increased efficiency. Available in vertical or horizontal types in sizes up to 10".

ADSCO RECEIVER SEPARATORS are recommended for use in steam lines to provide ample capacity for water or oil and to eliminate pulsation from reciprocating equipment. Deliver steam at uniform pressure, separate slugs of water and oil. Optional piping connections. Large range of capacities. Sizes from 1½" to 12", 150 psi and 300 psi, and for temperatures to 650 F.

← SEND FOR NEW, REVISED COMPREHENSIVE BULLETIN

Completely revised 16-page catalog of the entire line of strainers and separators. Contains selection data, descriptions, dimensions, weights and list prices. *Write for* Bulletin H-46-50A.

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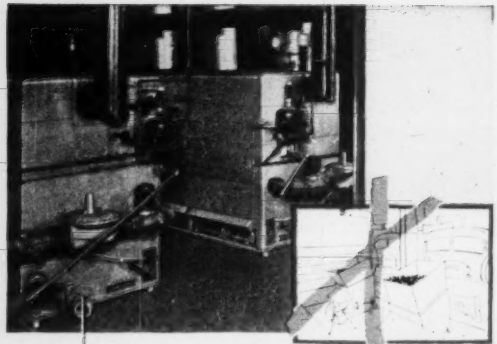
EXPANSION JOINTS — HEAT EXCHANGERS
STEAM TRAPS — STRAINERS — METERS
CASING — ANCHORS — GUIDES

Leaders Since 1877

AMERICAN DISTRICT STEAM CO
NORTH TONAWANDA, N. Y.



Two fuel-thrifty Mueller Climatrol Gas Boilers (20-S-81) now heat the 160-unit Saybrooke apartments in Pittsburgh. Replacing 3 bulky stoker-fired Boilers, they occupy only part of the former coal-bin. This replacement cut fuel-bills, and eliminated the annual $900 maintenance expense plus the monthly $260 labor expense.

Another case where

Mueller Climatrol

fuel-thrifty Gas Boilers

made a sale on savings

Type 20 Boiler

Type 10 Boiler

Type 11 Boiler

Sales come easy when you can prove savings — as was the case on the Saybrooke apartments described above.

Mueller Climatrol Gas Boilers are engineered to give you that kind of selling ammunition! You can go out after any hot-water or steam job — from 4 rooms to 400 — and stand a good chance of getting it.

These handsome, compact gas boilers are installed quickly and easily. Operation is quiet and economical. *Customers stay satisfied!*

Push the Mueller Climatrol Gas Boiler — for new installations and for profitable replacement business. Write for full details. L. J. Mueller Furnace Company, 2128 West Oklahoma Avenue, Milwaukee 7, Wisconsin.

93rd Anniversary

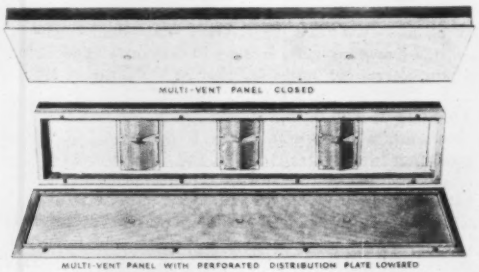
Mueller Climatrol

REG. U.S. PAT. OFF.

FOR GAS FOR OIL FOR COAL

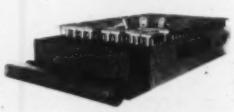
low velocity air distribution ceiling panel. This new size supplements current panels which come in 2 ft and 3 ft widths.

The new units are said to retain all of the features of the wider panels which are designed to introduce air through small perforations. According to the manufacturer, air is distributed entirely by displacement in such a manner that there are no air streams to aim and no change in air flow pattern when air supply is varied. Other advantages are said to include elimination of dirt streak problems on ceiling and wall surfaces adjacent to the diffusers and elimination of draft and noise problems.



The new size panel is manufactured in standard lengths of 2, 3, 4, 5, and 6 ft with one to three pressure displacement valves. It is especially designed for use where comparatively small volumes of air are required for cooling and is recommended for long, narrow peripheral zoning, such as along large window areas and under balconies.

HPAC 14—INDUSTRIAL GAS BURNER—The new GCV series commercial-industrial type gas burner of Iron Fireman Mfg. Co., 3170 W. 106th St., Cleveland 11, is available in capacities ranging from 450,000 to 11,520,000 Btu per hr input and more.



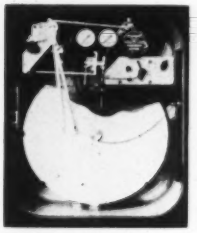
Designed for use with virtually all sizes of industrial and commercial furnaces and boilers, the unit is available in one assembly, made of manifolds, piping, draft box and draft doors. It is installed through the door or opening in the ash pit and burner heads are inserted in the sockets. The area between the burner heads and the sides of the box is closed off with a metal plate which leaves 1 in. clearance around the burner heads. No refractory combustion liner is used.

According to the manufacturer, the burner operates on an extremely low draft and draft controls are available but not essential. Various sections of burner heads can be controlled by independent manual or automatic valves. The draft box has interior divisions so that each separate group of burner heads has its individual air passage controlled at the front exterior of the draft box by separate sets of air doors. This is said to permit the various groups of burners to be operated in proportion to various heat requirements.

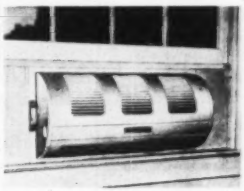
HPAC 15—AIR OPERATED CONTROLLERS—The new air operated controllers of Penn Industrial Instrument Corp., 3116 N. 16th St., Philadelphia 32, are com-

bined with the company's "Magna Clutch" flow meter, or its temperature, pressure and level recorders to provide automatic process control.

Controllers can be supplied with any of the control functions generally required for process work: on-off, proportional control, automatic reset, and derivative action. Both the nozzle and restriction have sapphire jewels to prevent wear due to dirt, water, or oil in the air. The nozzle is fixed with no adjustment possible and a restriction cleaning lever is provided to permit cleaning of the restriction while the controller is in service. The same relay is used for all types of controllers so that control action can be changed in the field.



Industrial Controller



Room Ventilator

HPAC 16*—ROOM VENTILATOR—The "Air Pilot" of Remington Air Conditioning Div., Remington Corp., Cortland, N. Y., is a room ventilator unit designed for rapid adjustment to bring in 100 percent outside air, to exhaust room air to the outside, or to provide a combination of ventilation and exhaust.

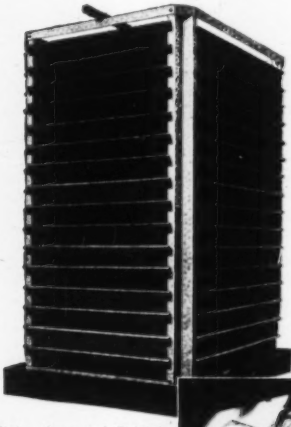
According to the manufacturer it can also be used to circulate room air exclusively. All incoming air is filtered to remove dust and pollen.

HPAC 17—SUMP PUMP—A new type TL sump pump, designed for general service and offered in standard models and special models for particular job requirements, is being produced by Byron Jackson Co., Pump Div., P.O. Box 2017, Terminal Annex, Los Angeles 54.

The pump is a vertical centrifugal type suspended from a circular support plate by a standard pipe column. It is offered in $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, and 4 in. models with capacities ranging from approximately 35 to 700 gpm at heads of 15 to 85 ft. Units are designed to handle solid-bearing liquids, the size of the solids being restricted to the strainer mesh size opening of the pump.

HPAC 18—MAGNETIC TRAP—Columbia Engineering Service Co., 173 14th St., San Francisco 3, is offering the "Cesco" magnetic trap for removing ferrous impurities from fluids. Until recently, says the company, the use of this trap was more or less restricted to the food and chemical process industry. Because of increasing demand, however, the company is now offering an industrial model for applications which do not require stainless steel and highly polished surfaces.

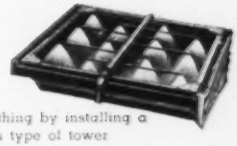
The trap is said to offer the maximum in magnetic protection for the removal of tramp iron from liquid and slurries because three forces are utilized: (1) gravitational force—the product is diverted downward so that the



Binks clog-proof Rotojet spray nozzles contribute much to the high efficiency of Binks towers. Their side-inlet, whirl-chamber design and precision manufacture assure maximum fluid break-up and long life.

SLASH your cooling water cost

install a **Binks** *natural draft cooling tower*



You can cut your cooling water bill to almost nothing by installing a Binks Type "S" Natural Draft Cooling Tower. This type of tower is excellent where air movement is unrestricted*. You recirculate the same water over and over, passing it through the cooling tower each time. A small pumping cost replaces high water bills.

Binks Type "S" Cooling Towers are made in a variety of types and sizes, handling from 15 to 1200 gallons per minute with high efficiency. These towers will provide you with many years of trouble-free service.

ideal for many applications

Binks Type "S" Cooling Towers are the accepted standard for cooling condenser circulating water from refrigeration and air conditioning compressors...for cooling water-jacketed engines...or for low-cost cooling in many manufacturing processes where heat is dissipated by spraying water or other fluids.

**Ask about Binks Mechanical Draft Towers for locations where air movement is limited.*

Send today for FREE Bulletins

which give full information about Binks Type "S" Towers:

Bulletin 30—Single section towers
Bulletin 31—Multiple section towers
Bulletin 32—Large capacity towers
Bulletin 40—All Redwood towers

Please state how tower will be used, also capacity required.

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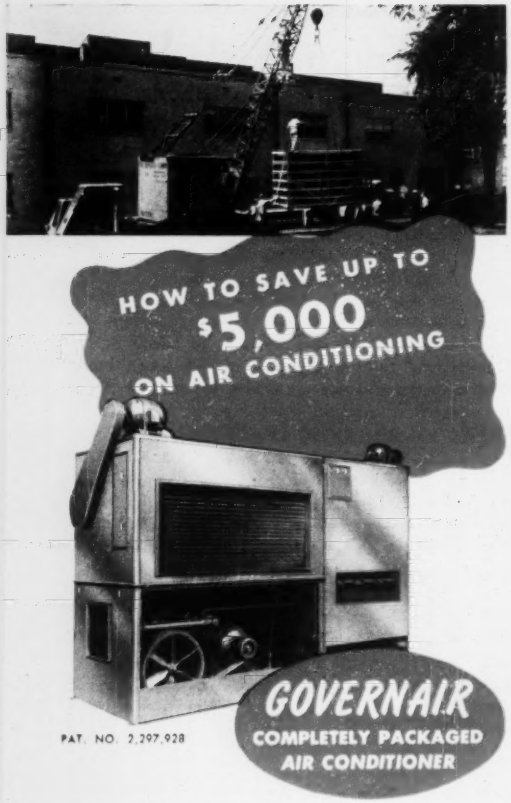
Binks MANUFACTURING COMPANY

REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3118-38 CARROLL AVENUE, CHICAGO, ILL.



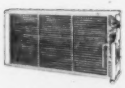
Save water! Save space! Save installation time and money! Save operating costs! Yes, install Governair and *save from $50 to $200 for each ton* of the completely packaged Governair unit designed to fit your needs!

Experience proves Governair can save you up to $5,000 on a 50-ton Governair unit that gives greater dependability and more "engineered efficiency" than ever before!

If you want the best — if you want the most economical and reliable air-conditioning unit on the market . . . CHOOSE GOVERNAIR and SAVE!

AIR CONDITIONERS

EVAPORATIVE CONDENSERS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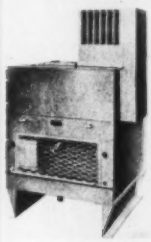
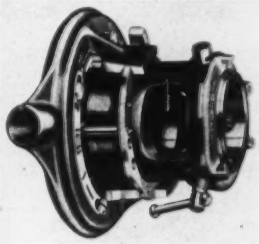
particles are directed for impact on the magnetic plate; (2) centrifugal force—the direction of the product is changed as it passes the baffle and particles heavier than the product tend to be thrown out of the stream at a tangent into a quiet zone by centrifugal force; (3) magnetic force—the product is passed through a concentrated magnetic field.

HPAC 19*—EVAPORATIVE CONDENSERS—McQuay, Inc., 1600 Broadway, N. E., Minneapolis 13, has expanded its line to include evaporative condensers which are now offered in $3\frac{1}{2}$, 6, and 12 ton sizes. Larger sizes, however, are planned.

Units have copper coils with all primary surface and are designed for floor mounting, but can be adapted for ceiling suspension and can also be used outdoors. Other features are said to include compact size, to permit easy handling and moving of units through small doors, removable front panels, refrigerant and electrical connections that come out of the front, and the use of low air velocities over the coil surface.

According to the manufacturer, the expanded line will eventually include cooling towers.


Condenser


Pipe Threader

HPAC 20—PIPE THREADER—According to Ridge Tool Co., Elyria, Ohio, the "Ridgid" 65R self contained threader is now jam-proof and does not need to be watched while threading pipe by hand or by power.

A new drive plate is said to automatically kick out the driving ratchet pawl when a standard length thread is cut. This is said to prevent the lead screw from jamming on the work holder. The improved model is available without increase in price and the new jam-proof drive plate is available for use on present 65R threaders.

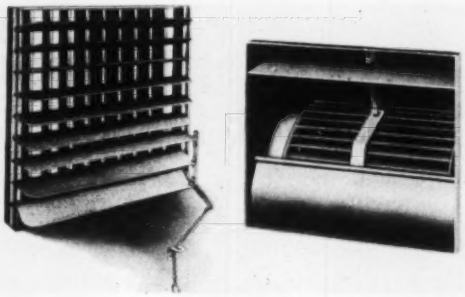
The unit remains otherwise unchanged and handles 1 to 2 in. pipe with one set of steel dies.

HPAC 21—BURNER FOR POWDERED COAL**—A new type heating unit designed to burn powdered coal has been developed by Blokolgas System, Inc., 70 W. Alexandrine, Detroit 1.

According to the manufacturer, powdered coal, fed through the carburetor, mixes with air and burns in suspension in the furnace, like a gas. Advantages are said to include high combustion efficiency, elimination of clinkers, soot and smoke, and small ash content. Ashes are collected in a receptacle in the furnace and are removed periodically through a vacuum tube, by the same truck that delivers the powdered fuel. Ashes are not carried out by hand.

The first units of the new burner are of the conversion type and are designed for commercial use.

HPAC 22—AIR DIFFUSER AND VOLUME CONTROL—The new "Strato-Diffuser" and the modulated volume control of United States Air Conditioning Corp., 33rd and Como Ave., S. E., Minneapolis 14, have been developed for use with evaporative coolers and are designed to provide a positive means of compensating for cool and moderate "in between" dry conditions and to prevent any discomfort caused by on or off blower operations.



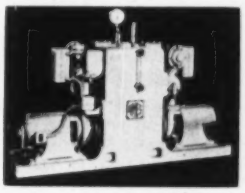
The diffuser is a deflection grille unit with vertical and horizontal blades individually adjustable. It is said to raise the air discharge stream above the room occupants.

The volume control is electrically operated to adjust the volume of the air discharged by the blowers.

HPAC 23—DRAFT GAGE—A new "Draftrite" pocket draft gage has been designed specifically for testing gas burners by Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh 8.

Said to be capable of testing the slightest draft or pressure inside the furnace and over the burner, it is also recommended for checking the draft at the relief opening of the draft hood.

The neutral pressure point or draft head on gas conversion burners is determined by opening the firing door slightly and pressing the slotted end of the draft tube, which is screwed into the back of the gage, against the opening at one side of the firing door. The instrument is then moved up or down until the pointer is at zero, which indicates the location of the neutral pressure point. According to the manufacturer, the gage indicates pressure or draft as low as 1/1000 in. of water.



Vacuum Heating Pump

Left: Pocket Draft Gage

HPAC 24—VACUUM HEATING PUMPS**—The new vacuum heating pumps developed by Chas. F. Ames, 140 E. 46th St., New York 17, are available as single or duplex units with ratings from 2500 to 100,000 sq ft EDR.

In the duplex unit, both pumps can be operated simultaneously to provide high capacity for starting. The

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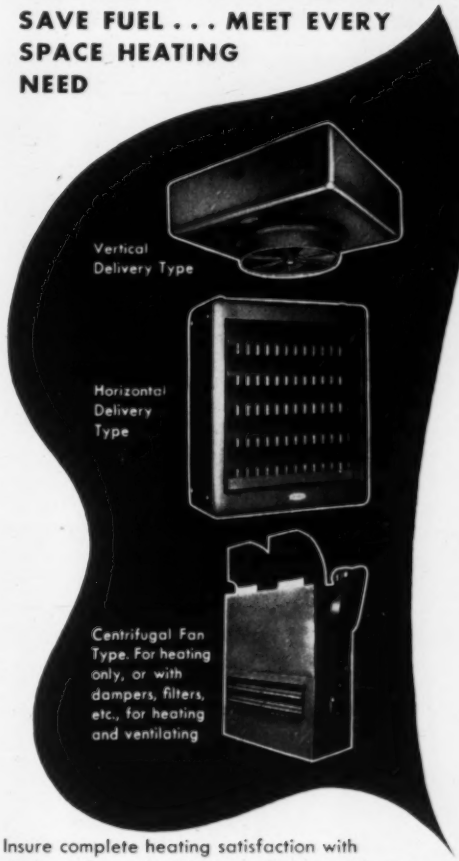

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LonGrip Jaws protect polished pipe in RIDGID vises

● You get years of trouble-free service with this more-for-your-money RIDGID Bench Yoke Vise. You like its easier-work features — integral pipe rest, handy bender that won't flatten pipe and LonGrip jaws that protect polished pipe. Special malleable frame and heat-treated tool-steel jaws for maximum wear. Made in 8 sizes, for pipe to 6." RIDGID bench, post, stand and Tristand pipe vises, yoke and chain types, all offer you real work-saver advantages. Buy them at your Supply House.

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WORK-SAVER PIPE TOOLS
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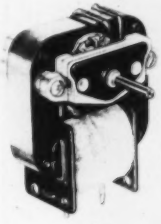
single impeller centrifugal pump is connected to a sealed ball bearing motor and is mounted on a base to "insure permanent alignment and vibrationless operation." Other features are said to include leakproof design, the use of a cast iron receiver with all internal functioning parts of bronze or stainless steel, and the arrangement of parts to facilitate inspection.

HPAC 25—RELIEF VALVE—The "Tempo" valve of A. W. Cash Valve Mfg. Corp., Decatur 60, Ill., is a new automatic reseating temperature and pressure relief valve.

It is offered in several different types and specifications and features a bellows assembly which is out of the water. This, says the company, prevents liming.

Relief Valve



Motor

HPAC 26—FRACTIONAL HORSEPOWER MOTOR—Raytheon Mfg. Co., Motor Div., Russell Electric Co., 4501 S. Western Blvd., Chicago 9, has developed a number of improvements in its type 230 fractional hp motor.

Manufacturing techniques have been worked out whereby a more uniform air gap is produced around the stator of this 1/200 to 1/50 hp motor. This is said to result in longer motor life and a substantially freer and quieter operation.

Recommended for use with fans, blowers, heating equipment and for similar product applications, the motor is said to have a flat speed torque curve and unusually high starting and pull-out torque.

HPAC 27—AUTOMATIC MOISTURE ELIMINATOR—A pet cock with a "brain" which automatically ejects moisture and oil from air brake systems, air line traps and air compressors is being produced by Master Equipment Corp., 15 N. Broadway, Dayton, Ohio. Called "Drain Master", it is 2 in. high, weighs 3½ oz.

According to the manufacturer, the device operates on the build-up and relief of pressure, automatically ejecting all water and oil, twice for each operation of the equipment. It is made in two different models; one for automotive air brake systems, the other for industrial applications.

HPAC 28—GAS FIRED UNIT HEATER—The new 25,000 Btu per hr "Cadet" gas fired unit heater of Reznor Mfg. Co., Mercer, Pa., is a suspended type unit designed for use in housing projects, apartments, offices, shops, etc.

The fan has two speeds, the higher speed being provided for summer ventilation. When a switch is turned to winter operation, the fan is controlled automatically.

American Blower—a time-honored name in air handling

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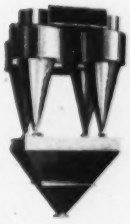

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In New York, as in other cities, American Blower Air Handling Products serve commerce, industry and public utilities. For air handling data in the New York area, call American Blower—Bryant 9-2885. In other areas, consult your phone book.

If you look before you buy, we're certain you'll buy American Blower Air Handling Products. There's a big difference in quality, design, quietness, operating costs and efficiency. Test after test by buyers has proved American Blower superiority.

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WHEN you buy American Blower equipment, you're buying the results of research—research in ventilating, heating, cooling, drying, air conditioning, collecting materials from air; and air handling, that dates back to the very beginning of the industry.

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To buyers of air handling equipment, they mean higher quality, longer life and lower operating costs over the years.

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ULTRALITE Duct Liner reduces fan chatter to a w-h-i-s-p-e-r—and it's so easy to install! The long glass fiber captures and absorbs fan noise, lets heating and air conditioning systems run at peak efficiency without disturbing anyone.

And ULTRALITE Duct Liner is easier and more economical to install than any liner you've ever used! You can cut it with a knife . . . run it quickly around curves and corners . . . fasten it securely in place with cement or screws and washers.

For the same good reasons, you'll want to use ULTRALITE Duct Insulation. It goes on faster, cheaper, and does a better job of keeping heat and cold where they belong. You have a choice of *6 attractive vapor barrier facings*, one of which is tailor-made for your particular condensation problem.

ULTRALITE comes in easy-to-handle rolls, in various widths and densities. The long glass fibers are fire-resistant, non-corrosive, non-irritating and as permanent as glass itself. It will not settle, shake loose, delaminate or disintegrate under air movement or vibration.

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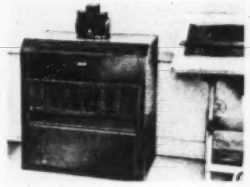
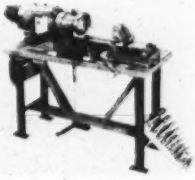
Distributors Conveniently Located Throughout the U.S.

HPAC 29—ROOM AIR CONDITIONERS—Versatility of application and low operating cost are said to be salient features of the new "Leader" models of console type room air conditioners available from Remington Air Conditioning Div., Remington Corp., Cortland, N. Y.

Units may be installed in any of the following three ways: within conditioned spaces where decorative finish is a secondary item; within conditioned spaces where a particular decorative scheme is to be carried out, by the use of special, custom-built enclosures; and where the unit is to be installed remote from the conditioned space and connected to it by ducts. Discharge and return grilles are designed for ready removal to facilitate the use of ducts and the evaporator fans, of the centrifugal type, are direct driven.



Room Conditioner



Hose Assembly Machine

HPAC 30—HOSE LINE ASSEMBLY MACHINE—Aeroquip Corp., Jackson, Mich., manufacturer of flexible hose lines with detachable fittings, is offering a hose assembly machine for large users of its hose lines.

While its hose lines may be hand assembled, the machine, model No. F-1766, is designed to enable large users to make up their requirements of specific lengths on short notice and on a production basis up to 600 percent faster than by hand assembly. The machine is mounted on a cast iron base and is equipped with a speed selector, tool steel mandrels, and interchangeable jaws.

HPAC 31—COMPRESSED AIR FILTER—Light enough to be classed as portable, a new compressed air filter is now available from E. D. Bullard Co., 275 Eighth St., San Francisco 3.

Standard ¼ in. tap threads are used to permit ready attachment of any air line fitting to operate all makes of spray guns or air tools, plus any type of protective air-line hood or helmet for operator protection. From one to six hoses may be attached. Working pressure is preset and controlled by a pop-off valve installed ahead of the manifold receiver. Capacity is from 10 to 35 cfm of free air, with a maximum working pressure of 100 psi. Combined chemical and mechanical air filtering is provided by a filter cartridge which is said to be inexpensively and quickly replaceable without special tools.

HPAC 32—PISTON TYPE CONTROL OPERATOR—A piston type pneumatic positioner, designed to provide a long stroke and surplus power, has been developed by Brown Instruments Div., Minneapolis-Honeywell Regulator Co., 4534 Wayne Ave., Philadelphia 44.

Known as the "Grad-U-Motor" air piston, the device has been field tested for numerous applications, including damper positioning and pneumatic temperature and pressure control systems. A noteworthy advantage is said to be the fact that stem travel is not confined to about 3 in.

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***WHAT IS IT?** It's the modern scientific discovery of transferring heat at the highest degree of efficiency with a new low in fuel consumption. Principal factors of which are the cylinderized solid flame with its exclusive cyclo-motion power, designed to utilize the full potential of every particle of fuel . . . and the thin layer of air resulting from centrifugal force that's always between the flame and wall of combustion chamber. A combination to produce steam far in excess of conventional standards for measured heating surfaces.

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Learn how the completely automatic Cyclotherm with its unexcelled all-in-one package type features wipe out waste and excess costs. If you are planning a new or replacement boiler installation it will pay you to first get the facts on Cyclotherm. The coupon below is for your convenience.

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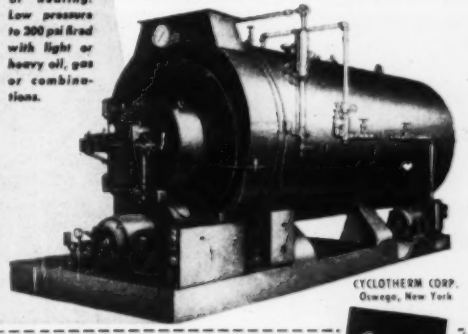

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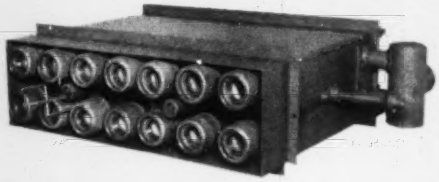

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- Will Operate at ONE POUND
- Will TURN DOWN to 1/2" Water
- Fires a SCOTCH MARINE BOILER without a dutch oven or refractory lining
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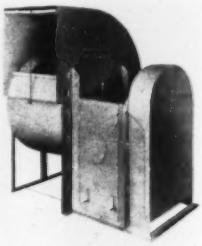
**Trade Mark*

HPAC 33—VENTILATING SET—The new utility ventilating set now being produced by United States Air Conditioning Corp., 33rd & Como Ave., S.E., Minneapolis 14, is recommended for use in schools, apartments, offices, hotels, hospitals, stores, factories, etc.

The new "Vari-Flo" control, especially designed for this model, is said to permit easy adjustment of air volume over a large range while maintaining efficiency. The unit may be made weatherproof with the addition of the belt guard, no changes or additions being necessary for outdoor installation. The motor and bearings are housed and are cooled by air drawn in through a slot in the bottom of the belt guard and discharged by the blower from an outlet in the fan housing. Sizes range from 800 cfm to 18,000 cfm at various speeds and pressures.



Ventilating Set

Temperature Control

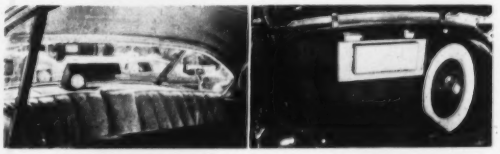
HPAC 34—TEMPERATURE CONTROLS—Crise Mfg. Co., Columbus 16, Ohio, has developed a new line of temperature controls.

The six models include a fan or limit control for warm air furnaces, a combination furnace fan and limit control, a two speed furnace fan control, both furnace and immersion types of hot water temperature controls, and a two circuit immersion type control having many applications on hot water heating equipment.

All controls are of the positive, snap action switch design with bimetal elements. Scale settings may be viewed through a plastic crystal without removing the housings. The differentials can be adjusted and permanently set by means of movable levers that lock in position with a knurled knob. The actual temperature of the medium being controlled is shown at all times.

HPAC 35—AUTO AIR CONDITIONER—Frigikar Corp., Box 686, Dallas, Tex., is offering an air conditioning unit for use in automobiles.

The only parts of the unit visible within the car's interior are the outlet and intake louvers, which are

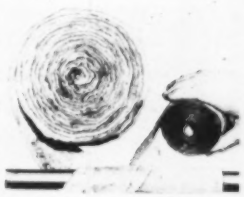


installed in the package tray, and the three-way switch on the dash. The unit has a rating, at varying speeds, of from 1 1/2 to 2 tons. The "Freon-12" compressor, built by Servel, Inc., is installed under the hood and is driven by a belt from the crankshaft pulley. According to the company, little if any power loss or additional fuel con-

sumption results. Also under the hood, between the car radiator and the grille, is the condensing unit. The evaporator is installed in the trunk compartment immediately in back of the rear seat and below the package tray. Insulated flexible tubes are used to connect the units under the hood and in the trunk. The condensing coil is located so that there is a continuous flow of air through it induced by fan suction when the car is standing still, and by combined fan suction and the car velocity when the vehicle is in motion.

HPAC 36—PIPE THREADER**—Weighing only 26 lb and powered by a $\frac{1}{2}$ hp motor, the "Port-A-Pony" power pipe threader is available from Thread-Ezy Mfg. Co., Corunna, Mich.

The portable unit is of cast magnesium alloy and is designed to handle $\frac{1}{4}$ to 4 in. pipe and to be adaptable to popular die stocks. A ring gear principle is used to turn the dies on stationary pipe and the reversing motor removes the "Pony" from finished threads.



Cold Pipe Insulation
Left—Pipe Threader

HPAC 37—COLD PIPE INSULATION**—"Wrap-On" insulation consists of glass fiber insulation which is wrapped around pipe, preferably with an overlap of one half so as to provide a double layer of insulation, and an outer wrapping of flexible tape, designed to be waterproof and to provide mechanical protection.

The insulation is particularly recommended for use on sweating pipes by the manufacturer, Gro-Quick Co., 340 W. Huron St., Chicago 10. A set of this insulation consists of 25 ft of 3 in. wide glass fiber insulation and 25 ft of 2 in. wide flexible tape.

HPAC 38—COOLING WATER CONTROL—A new insertion-type pneumatic temperature control for machines or processes using water as a cooling medium is said to be unusually small and can be installed in a 2 in. water line.

It is designed for use with pneumatic valves on restricted, recirculated and other systems, such as stationary gas or diesel engines, diesel locomotives, plastic presses and similar installations. A liquid-filled element is said to provide high sensitivity and fast action.

Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Wayne and Roberts Aves., Philadelphia 44.

HPAC 39—SAFETY AND RELIEF VALVES—A line of cast carbon and alloy steel safety and relief valves has been added to the bronze line of Kunkle Valve Co., 111 S. Clinton St., Fort Wayne 2, Ind.

The new constructions include all types formerly manu-

SYNCROMATIC

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HIGH CAPACITY

FAMOUS *Syncromatic* COUNTER FLOW
STEEL FORCED WARM-AIR FURNACES
HIGH CAPACITY WITH HIGH EFFICIENCY

OIL-FIRED
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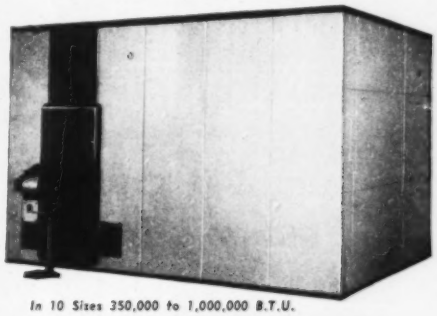

In 10 Sizes 350,000 to 1,000,000 B.T.U.

IF ORDERED KNOCKED-DOWN
CAN BE TAKEN THROUGH
A THREE FOOT DOORWAY

Heat Exchanger
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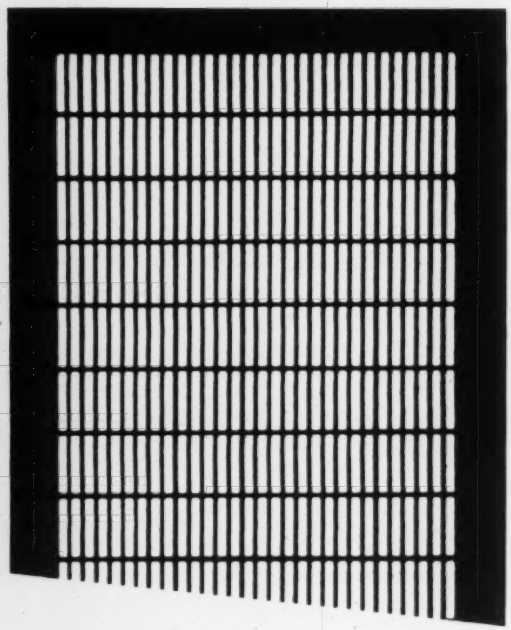


a practical grille for many purposes

Here is a Hendrick perforated metal grille particularly suitable for many types of installations, especially in schools and offices. The size of the slotted openings, 13/64" x 1½", prevents even as small articles as pencils being dropped through the grille, and yet there is 59% open area for the passage of air. These grilles can be furnished in aluminum, bronze, steel or stainless steel.

Hendrick Grilles are fabricated in accurate sizes, with clean-cut perforations and with no burrs or other imperfections; are easy to install; and always lie flat because of a special flattening operation in their manufacture.

There are over a hundred attractive designs of Hendrick Grilles from which to make selections. Write for detailed information.

SWEET'S

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring
"Shur-Site" Treads and Armorgrids

HENDRICK
Manufacturing Company
48 DUNDAFF STREET, CARBONDALE, PA.
Sales Offices in Principal Cities

factured by Star Brass Co., whose facilities have been purchased by Kunkle. A typical valve, the Fig. 73, is of cast carbon steel with stainless steel trim for pressures to 600 psi, temperatures to 650 F. It is offered in sizes from ¾ to 6 in. and has an ASA standard flanged inlet and flanged or screwed outlet. The valve is said to be a Navy approved adaptation with high discharge capacity and close blowdown control. Other valves for air, steam, gases, vapors and liquids and for a wide range of pressure and temperature applications are available.

HPAC 40—SMALL TURBINE PUMP—A new, small vertical turbine pump incorporating glass lined bowls and bronze impellers has been introduced by A. O. Smith Corp., Milwaukee. Named the "Watermaster," it is adaptable to deep wells as small as 4 in. diameter.

Equipped with the company's vertical hollow shaft electric motor, the unit delivers 15 to 115 gpm. Design features include an adjustment on the drive head to change capacity or pressure, closely spaced synthetic rubber bearings, and ¾ in. stainless steel shafting. An oversize foot valve is designed to hold water in the column at all times and the valve face is rubber lined and mounted in an inclined position to prevent sticking or clogging in the presence of sand.

WE HEAR THAT . . . .

A new $1 million extrusion plant for the fabrication of tubes of ferrous metals and alloys in complex sectional shapes, will be built by **Babcock & Wilcox Tube Co.** at the site of its present facilities in Beaver Falls, Pa. The decision to build the new facilities is a result of a licensing agreement between the company and Comptoir Industriel d'Etirage & Profilage de Metaux, Paris, France, developer of the process and holder of the patent rights.

The new quarters of the **General Electric Co.** research laboratory are nearing completion near Schenectady and will be completely occupied late this month. Construction on the revolutionary type of laboratory structure began in 1946, and exclusive of minor service buildings, the laboratory plant totals five buildings which include the main five story building, a radiation laboratory, a low temperature laboratory, and a chemical pilot plant, together with shops for machine work, woodworking, welding, glass blowing, and electronics.

Westinghouse Electric Corp., Pittsburgh, is building a new plant in Birmingham, Ala., which will be operated by the manufacturing and repair department. It will provide extensive overhaul and repair facilities to serve customers in all parts of the state.

Youngstown Sheet and Tube Co., Youngstown, Ohio, plans to build four new open hearth furnaces and other facilities at its Indiana Harbor plant, East Chicago, Ind. A new roll shop will be erected and finishing facilities will be added for hot rolled sheets and strip. After the new furnaces are in operation, the Bessemer department at Indiana Harbor will be discontinued. These additions and other changes and improvements already made will give the company an estimated ingot capacity of 4,500,000 tons.

Kennard Corp., St. Louis, is completing its second plant expansion in the last six months. The first addition, completed last April, added 40 percent to the plant's production space. The latest addition will increase it another 30 percent. According to the company, increased business and a growing line of products have necessitated the second expansion. . . . . **Johnson Service Co.**, Milwaukee, has recently completed construction of a modern two-story building in St. Louis and has added a second story to its Pittsburgh branch. The company has also purchased a new building in Toronto for its Canadian subsidiary, **Johnson Temperature Regulating Co. of Canada, Ltd.** In addition to these new properties, the branch offices at Albuquerque, Columbus, Ohio, Charlotte, N. C., Portland, Me., and San Francisco have been moved to larger and more convenient locations.

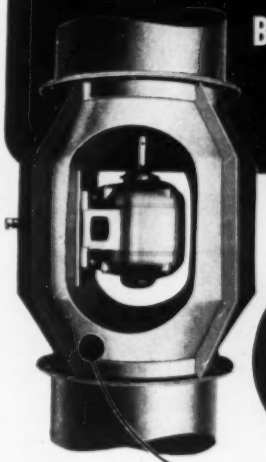
BIF Industries of Canada, Ltd., Toronto, Ontario, a subsidiary of **Builders Iron Foundry**, Providence, R. I., was recently formed for the manufacture of certain products made by **Builders-Providence, Inc.**, and **Omega Machine Co.** In particular, the firm will produce venturi meters, flow controllers and gages, chlorine gas feeders, and gravimetric and volumetric chemical feeders. Sales of these products in Canada will continue to be handled by **Keith Mercer, Reg'd.**, 1100 Craig St., East, Montreal 24, Quebec; **Control and Metering, Ltd.**, 454 King St., West, Toronto 2B, Ontario; and **Bayfield and Archibald**, 448 Seymour St., Vancouver, B. C.

This month, **Brown Instruments Div., Minneapolis-Honeywell Regulator Co.**, Philadelphia, opens the second half of its 1950 maintenance repair courses. Classes will be held on a three, five and thirteen week basis, the shorter courses being for concentrated product instruction, the longer courses for more comprehensive training. According to the company, the courses will again be fitted to the specific requirements of customers who will send employees to the school.

Thomas Robertson & Co., Ltd., Montreal, has been appointed a distributor of welding fittings and flanges by **Tube-Turns, Inc.**, Louisville, Ky. With branches in Ottawa and the city of Quebec, the firm will also represent **Tube Turns of Canada, Ltd.** . . . . A new selection manual of **Anemostat Corp. of America**, New York, was recently awarded the Certificate of Merit for outstanding product literature by the American Institute of Architects. Presentation of the award was made at the recent annual convention of the institute, in Washington, D. C.

Phillips Cooling Tower Co., Inc., has moved to 220 Dupont St., Brooklyn 22, N. Y. . . . . Changes now underway in the "Thermopane" factory of **Libbey-Owens-Ford Glass Co.**, in Rossford, Ohio, include the rearrangement of machinery to provide additional production lines so as to double plant capacity and the construction of a new modern factory office. . . . . The Detroit wholesale branch of **Frigidaire Sales Corp.**, supplying dealers throughout greater Michigan and handling appliances, commercial refrigeration and air conditioning products, is occupying a new, modern building at 13940 Tireman Ave. The move is expected to permit the branch to meet greatly expanded distribution demands.

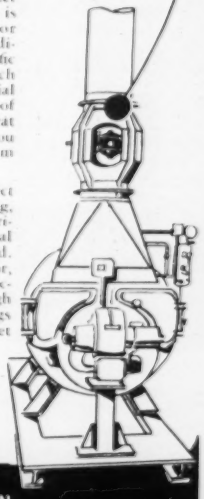
No Guesswork with
DE BOTHEZAT
Induced Draft
BIFURCATOR
FANS



SOLVE DIFFICULT STACK PROBLEMS THIS ECONOMICAL WAY

Let DeBothezat's trained engineers recommend the right Induced Draft Bifurcator Fan for your particular boiler application. DeBothezat fan selection is not based merely on boiler HP or pounds of fuel fired per hour. In addition, consideration is given to specific temperatures, the resistance of each boiler to airflow, and other confidential data furnished on each make and size of boiler by the manufacturer. DeBothezat eliminates guesswork and assures you of the correct size fan for maximum efficiency.

The DeBothezat Bifurcator is a direct motor-driven fan with a divided housing, easily installed in vertical stack or horizontal or angular breeching. No special platforms or supports are required. Gases are by-passed around the motor, which remains cool, clean and easily accessible. Standard fan sizes 12" through 27", for boilers having nominal ratings up to 550 BoHP, or 19,000 square feet of radiation.



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See how the DeBothezat Induced Draft Bifurcator Fan works. Descriptive illustrated bulletin is yours without obligation. Address Dept. H850.

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AMERICAN MACHINE AND METALS, INC.
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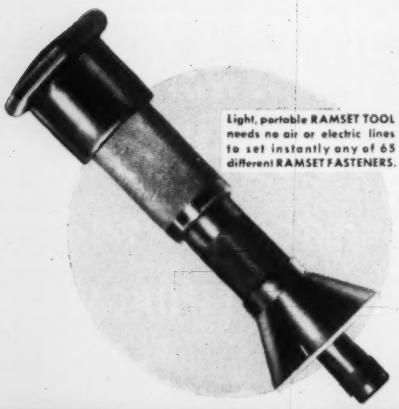

RAM COSTS DOWN with Ramset Fastening System

Quicker than lightning, the self-contained RAMSET TOOL instantly sets drive pins or threaded studs through steel or wood, into steel, concrete, masonry, other hard materials. Slashes costs and time up to 80% for such fastening jobs. Takes less than a minute from start to finish.

1. **No drilling, chipping, plugging, tapping.**
2. **Insert RAMSET FASTENER into tool, with power charge.**
3. **Place against work spot. Then RAM! The fastener sets, instantly, tightly.**
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6. **Nothing heavy to haul. RAMSET TOOL can be carried in one hand and used in tight, confined spaces.**
7. **Small first cost, pays for itself quickly—and it's savings and profit from then on!**

A 15-minute demonstration will prove the cost-reducing, time-saving values of RAMSET SYSTEM . . . the pioneer in powder-actuated fastening methods. Call your local RAMSET Specialist or use coupon for complete details.

STEMCO CORPORATION
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ASK FOR DEMONSTRATION AND DETAILS!

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Please send further information on cost-cutting, time-saving value of RAMSET FASTENING SYSTEM.

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HP

Mine Safety Appliances Co., Pittsburgh, recently dedicated the "world's largest research laboratory devoted to the development of safety equipment for all industries". About 400 leaders in safety and industrial hygiene and health, as well as industrial executives, attended the dedication exercises, at which the principal speaker was **Ned H. Dearborn**, Chicago, president of the National Safety Council. Facilities of the new laboratory will be used in developing equipment and devices to combat hazards of all types, including air pollution and atomic energy. Research will be continued to improve existing safety devices and rescue apparatus.

Upwards of 5000 people attended the recent opening of **National Supply Co's.** new Odessa, Tex., store. A two-day open house was held in honor of the establishment of the company's newest permanent oil industry supply store, which includes a modern brick and concrete building and a block long field warehouse and crane section. It is expected that the new facilities will insure faster, better service for the oil industry in the Permian Basin.

A 24 page bibliography of construction films available from building product manufacturers has been prepared by the **Producers' Council**, 815 Fifteenth St., N. W., Washington 5, D. C. The list includes 67 films prepared by 27 companies and covers a wide range of products and building techniques. Most of the films are 16 mm sound movies, many of them in color, and the running time in most cases is 20 to 30 min. All of the films are available without charge to responsible groups.

International Register Co., Chicago, manufacturer of time switches, has appointed three new representatives and an additional service station. The representatives are: **E. T. Vonier Co.**, 1160 Elati, Denver 3; **Cooper & Weiss**, 81 Murray St., New York 7; and **S. H. Colman Co.**, 17 William St., Newark 2, N. J. The new service station is **Abbott Electric Co.**, 1101 Eastlake Ave., Seattle, Wash.

A series of free factory training school sessions is being conducted by **Perfex Corp.**, Milwaukee, in conjunction with the **Milwaukee School of Engineering**. The series began last month and a new course, starting every Monday, is offered to dealers and wholesalers, their servicemen and salesmen. Each three-day course includes instruction in the basic fundamentals of heating, including the operation, installation and servicing of automatic heating controls, and a tour of the factory.

Star Steel Supply Co., Detroit, has been named a distributor for the State of Michigan by **United States Air Conditioning Corp.**, Minneapolis. The firm will distribute gas fired heaters. At the present time, the Detroit organization is in the midst of a $500,000 expansion program. . . . . **Capitol Distributors, Inc.**, Dallas, appliance distributor handling room air conditioners of **Remington Air Conditioning Div., Remington Corp.**, Cortland, N. Y., recently sponsored what it believes to be the largest concentrated newspaper advertising effort ever made on behalf of room air conditioners. Sixteen retail dealers were represented by individual advertisements in a special six page section in a Sunday edition of the Dallas Daily Times Herald. Sales results on the retail level were

said to be immediate and highly satisfactory. Costs of the promotion were shared by dealers, distributor, and manufacturer under Remington's standard cooperative advertising plan.

The **Refrigeration & Air Conditioning Contractors Association** has approved applications for two new local associations. A group has been organized in Tampa, Fla., to be known as the **West Coast Air Conditioning and Refrigeration Contractors Association.** Officers are: **W. B. Haggerty,** president; **Arthur Turner, Sr.,** vice president; **Charles Caccamo,** secretary-treasurer. A second group at Jackson, Miss., is known as the **Refrigeration and Air Conditioning Contractors Association of Mississippi, Inc.** Officers for this local are: **W. T. Tyson, Jr.,** president; **L. B. Brummett,** vice president; **E. C. Aldridge, Jr.,** secretary-treasurer; and **W. C. Piatt,** sergeant-at-arms.

Air Reduction Sales Co., a division of **Air Reduction Co., Inc.,** New York, has been named national distributor for the welding industry of the recently introduced "Prepo" torch. ..... **Union Malleable Mfg. Co.,** Ashland, Ohio, has named two new sales representatives. **Kent Engineering Co.,** Denver, is handling the Rocky Mountain territory, and **Stuart S. Wills,** 5736 Twelfth St., Detroit, is covering the Detroit and southeastern Michigan district.

Because of an urgent need for additional manufacturing space, **Remington Air Conditioning Div., Remington Corp.,** Cortland, N. Y., has acquired a manufacturing plant in Auburn, N. Y. The new acquisition was formerly a part of the Auburn works of International Harvester Co. and will provide six times the floor space of Remington's present plant. ..... **Farris Stacon Corp.,** with main offices and plant located in Palisades Park, N. J., was recently formed to purchase the patents, equipment, machinery, inventory, and records of **Edison Stacon Regulating Valve Division** from **Thomas A Edison, Inc. (Instrument Division.)** According to **V. W. Farris,** the new organization is the nucleus of extensive plans to develop industrial instrumentation and temperature control equipment.

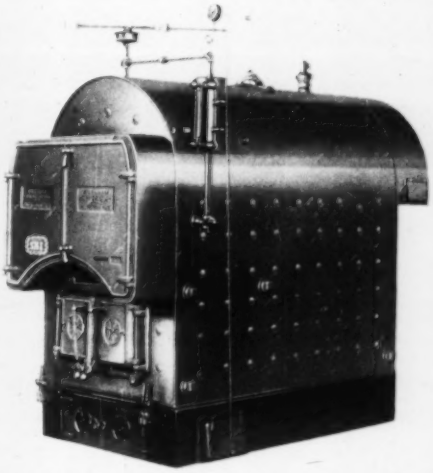
Fireye Corp., 77 Broadway, Cambridge 42, Mass., has developed the FD-10 fire protection system which is designed to provide complete coverage throughout a room or fire zone and which utilizes the photoelectric principle. It is said to be capable of detecting a very small fire, yet is designed to ignore extraneous light of any intensity, such as the sun or artificial illumination. The protection block, consisting of six detectors in one control panel, provides coverage up to 120 × 80 ft. For areas larger than this, combinations of protection blocks may be made.

For users of fractional horsepower motors, a new motor unit is offered by **U. S. Electrical Motors, Inc.,** 200 E. Slauson Ave., Los Angeles 54. It is said to combine in one unit a "Varidrive", which permits instant change of speed in a ratio of 1 to 10, and a heavy duty "Syncrogear" for increasing the torque. Known as the type VA-GD and available in ¼, ⅓, ½ and ¾ hp, it is said to be unusually compact and to have a speed range from 10 to 10,000 rpm.

BURNHAM

COMPACT TYPE

WELDED STEEL BOILERS



Large capacity in less space

Take advantage of Burnham's long experience in building fine steel boilers. Here's quality and efficiency you can depend on. Burnham steel boilers are giving a good account of themselves in schools, apartment houses, churches and greenhouses all over the country.

Capacities range from 3,000 to 35,000 square feet.

The famous Burnham fire travel, 3 times back and forth the length of the boiler, scrubs maximum heat from the fire. Quick steaming without priming. Low water line—easily installed. Adaptable for all fuels. Can be equipped with tankless or storage type hot water coils.

Built in accordance with ASME Code. Ratings conform to SBI Code.

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"PIONEERS OF RADIANT BASEBOARD HEATING"

IRVINGTON, N. Y.

MAIL coupon today for folder SB-103 containing full details, ratings and installation data.

Burnham RADIANT HEATING SINCE 1873

Burnham Corporation Dept. HP-80
Irvington, N. Y.
Please send me Folder SB-103 on Compact Steel Boilers.
Name .....
Address .....
City ..... State .....

New filters which are said to make possible completely dust-free conditions in industrial operations, for the first time at a reasonable cost, were described at the U. S. Technical Conference on Air Pollution, recently held in Washington, D. C. The filters were developed by **Arthur D. Little, Inc.**, Cambridge, Mass., for the Atomic Energy Commission and are used to catch radioactive dusts. Although the filters are not yet available for private use, arrangements are being proposed to manufacture them commercially, and it is expected they will be available through regular channels. According to the company, of the 20,000 particles which might be in a cubic inch of ordinary atmosphere, good conventional methods of air cleaning will pass 1000 to 3000, but the new filter will, on the average, pass only a single particle. The filtering medium is a special soft and felt-like paper containing sub-microscopic asbestos fibers.

Helically wrapped heat transfer surface is available in various sizes from **Keeprite-Eastern, Inc.**, 459 Amboy Ave., Woodbridge, N. J. Available in virtually any combination of fin and tube size, surfaces can now be furnished with aluminum fins, as well as copper. Units are recommended for baseboard heating, oil industry applications, and for air conditioning. Also available from the firm is a rectangular finned surface incorporating two tubes. This is made on a newly designed and patented machine, 80 ft long and fully automatic in operation. Finned tubing of the company is generally manufactured to customers' specifications, rather than in standard sizes and materials.

A new line of automatic speed controls for its PIV (positive, infinitely variable) speed drive has been developed by **Link-Belt Co.**, 307 N. Michigan Ave., Chicago 1. The new controls are designed for automatically controlling the output speed range of the drive and are available in four basic types: electronic; hydraulic; pneumatic; and mechanical. Numerous applications are said to include separate machines which must be kept in accurate synchronization, often over a wide range of operating speeds; and where temperature, velocity, pressure, liquid levels, and flow of materials must be held to narrow limits despite variations in operating conditions.

A new coating, said to provide unusual protection against rust and corrosion on metal surfaces, has been developed by **S. C. Johnson & Son, Inc.**, Racine, Wis. This new wax is designed to give aluminum, steel, brass, and other ferrous and nonferrous metals a dry coating resistant to salt spray, high humidity and hazards of outdoor exposure. In addition to its protective property, the wax is said to dry tack free in less than 10 min after application. It may be applied by the conventional dip, brush, wipe or spray methods and when dry, leaves a transparent film on the metal. According to the company, it is not removed through handling or contact with packing materials.

Tobey Mfg. Corp., 1221 El Segundo, Blvd., El Segundo, Calif., has developed an A frame designed for handling sheet metal, glass, plastics and other materials commonly

9 out of 10 New Homes Heat with OIL or GAS

You Sell BOTH Markets with ALDRICH HEAT-PAK BOILER-BURNERS

Expand your market to 90% of new home construction with Aldrich. Sell more, with less inventory . . . cash in with oil units, cash in again with gas burners.

Mounting plates are similar; installation is fast and simple. And you can convert from one fuel to another without changing boiler set-up or performance.

7 makes 14

Aldrich Heat-Pak boilers come in 7 sizes, from 100,000 to 808,000 BTU/hr. With both oil and gas, you have 14 compact heating plants to sell everything from modern small homes to big commercial installations. Vertical-type, compact and efficient; shipped crated fully assembled, ready to set in place and connect.

Profit with ALDRICH—Get Details Today. Write or wire for Heat-Pak facts, full specifications.

ALDRICH HEAT-PAK PRODUCTS

The ALDRICH Company

105 East Williams Street, Wyoming, Ill.

A Subsidiary of Breeze Corporations, Inc.

ANOTHER BREEZE MARK PRODUCT

handled in sheet form. Of bolted and riveted construction, the frame is available with felt covered bearing surfaces to eliminate the possibility of scratching sheets being carried. The frame may be equipped with wheels and casters and is available in virtually any size or capacity.

Power Chemicals Div., E. F. Drew & Co., Inc., 15 E. 26th St., New York 10, has developed a total alkalinity indicator, the end point of which is said to occur at exactly the same pH as methyl orange. According to the company, it is used in exactly the same manner as methyl orange, but gives a clearer and more distinct end point.

Formulated to protect metals subject to temperatures ranging from 500 to 1200 F, a new "Tecosteel" aluminum paint is applied like ordinary paint without the use of a primer. According to the manufacturer, **Thompson & Co.,** Oakmont, Pa., the paint air dries in 12 to 18 hr and can be baked dry at 350 F in 15 min. It can be brushed, sprayed, or dipped, and is recommended for annealing boxes and furnaces, industrial ovens, smoke stacks, hot air ducts, superheated steam lines, economizer tubes, boilers, etc.

Important features of its new 14 in. aluminum pipe wrench are emphasized on a new counter display recently introduced by **J. H. Williams & Co.,** 400 Vulcan St., Buffalo 7. A wrench is attached to the display unit by fitting the jaws over a simulated pipe section. . . . . The "Vapotester" of **Davis Emergency Equipment Co. Inc.,** Newark, N. J., is now listed by the Underwriters' Laboratories. Also approved by the Laboratories of the Associated Factory Mutual Fire Insurance Companies, the instrument is used for the detection of combustible gases and vapors.

Lehigh Mfg. Co., Lancaster, Pa., has developed a new automatic high side defrost condensing unit for temperature applications of 32 F and below. For use with any evaporator, the unit utilizes a low and high pressure control, both reverse acting, to start the defrost cycle and revert to cooling. These controls energize a solenoid operated 4-way reversing valve which is used to reverse the flow of refrigerant. Heat for defrost is obtained from the unit high side condenser which, on defrost cycle, serves as the evaporator.

Designed primarily for light duty, slow speed antifriction bearing applications, the "Flangette" is available from **Fafnir Bearing Co.,** New Britain, Conn. It consists of two pressed steel stampings to form a flanged housing enclosing a self aligning, wide inner ring type ball bearing. Light weight, sealed-in lubrication, and ease of installation are said to be advantages. It is offered for 18 sizes of shafts ranging from ½ to 2-3/16 in.

A new, mild steel E6012 electrode, "Fleetweld 72" has been developed by **Lincoln Electric Co.,** Cleveland 1, for high speed production of single fillet and lap welds in the flat or horizontal positions. The company has also introduced the LJ-1 insulated electrode holder. It is said to be unusually small, to combine the advantages of both tong and hole type holders, and to incorporate an easy-thumb-pressure electrode release.

CAUTION

to Ventilator Buyers

If you want to *be sure* of what you're getting when you buy ventilators, insist on *certified* capacity ratings based on tests made with wind blowing in *all* directions, as indicated below.

The First Scientific Improvement in Ventilators in over 50 Years!

Breidert Air-X-Hauster Type B

Only such tests can guarantee the capacities a ventilator will deliver under actual operating conditions! Don't be misled into buying on size alone. Insist on the correct size for the capacity required.

The Breidert Air-X-Hauster has been tested by Smith, Emery & Co. of San Francisco, Pacific Coast branch of the Pittsburgh Testing Laboratory, with wind directed at *all* angles shown above. It is the *only* ventilator on the market with published certified ratings based on such tests. Breiderts are extensively used on industrial, commercial and residential buildings all over the country, and on most types of pleasure craft and ships.

For detailed information and free Engineering Data Book on the Breidert, send the coupon.

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☐ Send name of nearest Breidert representative.
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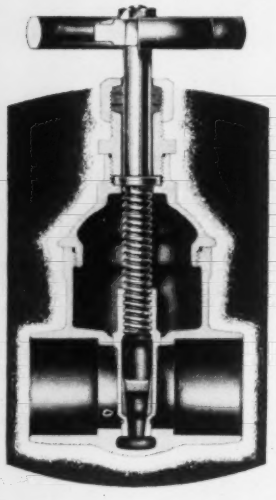
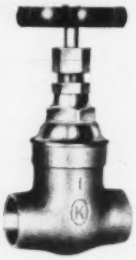
Whenever you use copper tube use a KENNEDY Solder Joint VALVE





Sizes available—⅜" to 2"

Whether it's a water supply system, a radiant heating job, or an industrial coolant piping system, if you are using copper tube you will save installation time and assure yourself of a dependable flow control installation when you install KENNEDY Solder Joint Valves.

Made throughout to the same unsurpassed quality standards as KENNEDY Screwed and Flanged Gate Valves they offer you the service assurance gained in 73 years of valve-making experience plus the modern ease and speed of installation to be had from a solder joint connection.

Sockets are smooth with precise clearance to assure free, even flow of solder all around for a solid, leak-proof joint.

The new cylindrical design of the upper part of the body provides maximum strength with light weight. It equalizes pressure, resists strain and gives the extra rigidity that prevents distortion of the body.

KENNEDY Fig. 1-SJ Solder Joint Valves are recommended for low pressure steam (not exceeding 15 pounds gauge) and 150 pound water services at temperatures up to 250 degrees F., when joints are made up with ordinary solder. They are also recommended for steam services up to 100 pounds and temperatures up to 450 degrees F., when suitable solder or low temperature brazing alloy is used.

WRITE FOR BULLETIN 103 • BUY FROM YOUR LOCAL DISTRIBUTOR

THE KENNEDY VALVE MFG. CO.
1053 EAST WATER ST.
ELMIRA, NEW YORK
VALVES • PIPE FITTINGS • FIRE HYDRANTS

OFFICE WAREHOUSES IN NEW YORK, CHICAGO, SAN FRANCISCO • SALES REPRESENTATIVES IN PRINCIPAL CITIES

WHO'S WHAT

C. Douglas Porch, president of **Kinetic Chemicals, Inc.**, Wilmington, Del., for many years an affiliate of **E. I. du Pont de Nemours & Co., Inc.**, retired last month. He had been with du Pont and Kinetic for more than 43 years. Kinetic, fully owned by du Pont since last December, is being integrated with operations of the company's organic chemicals department, and a new Kinetic Chemicals Division has been set up to handle sales of the "Freon" fluorinated hydrocarbons. The division is headed by **Robert J. Thompson** as director of sales and **Emory M. Fanning** as assistant director. The manufacture of the compounds is in charge of **Stuart W. Pratt** as production manager. He is a member of du Pont's organic chemicals production organization.

Johnson Service Co., Milwaukee, has elected four additional officers: **Arthur J. Otto**, vice president; **Richard J. Murphy**, vice president and treasurer; **J. Rexford Vernon**, secretary; and **Louis V. Zacharyasz**, assistant secretary and assistant treasurer. In more definitely outlining the work of the various sections of its engineering department, the company has designated **Otto Scharf** as chief development engineer, **Harold W. Alyea** as chief field engineer, and **Henry F. Wohrer** as chief test engineer.

Prof. F. B. Rowley, head of the department of mechanical engineering, University of Minnesota, and director of the university's engineering experiment station, has retired in accordance with university regulations. **Prof. R. C. Jordan** has taken over his position in the mechanical engineering department as acting head of the department, and the position of director of the engineering experiment station is being filled by **Dr. Ralph Montonna**, formerly professor of chemical engineering and assistant dean of the graduate school of the University of Minnesota but more recently director of research at Syracuse University.

George I. Bottcher, who joined the engineering department of **Allegheny Ludlum Steel Corp.**, Pittsburgh, in 1941, was made construction engineer in 1946, and was appointed assistant chief engineer in 1947, is now chief engineer. Newly named assistants to him are **J. F. Chapman** and **R. E. Smith**. Mr. Chapman will be in charge of design and construction engineering and Mr. Smith retains his duties of office manager and will supervise the procurement and expediting of materials, as well as supervise plant maintenance problems. **Royden C. Presley** has been named district sales manager of the Birmingham, Ala., area. He had been manager of the Toledo sales office and now succeeds **C. H. Vaughan**, recently resigned.

Kritzer Radiant Coils, Inc., Chicago, has named **Mel W. Knight** general sales manager and **C. G. Newton** chief engineer. Mr. Knight has spent the past 17 years as general sales manager of Peerless of America, Inc. Mr. Newton, from 1932 until joining the Kritzer organization, was vice president and chief engineer of Kehm Corp. . . . **Capt. Howard Thomas Orville**, prominent Navy aerologist and one of the nation's foremost weather authorities, has retired after 29 years to become director of engineering for **Friez Instrument Div., Bendix Aviation Corp.**, Baltimore.

Kenneth A. Weatherwax has been elected president of **Acme Industries, Inc.**, Jackson, Mich., succeeding the late **Roy C. Weatherwax**, who died after an illness of several months. . . . **Carl E. Buchholzer** is now vice president and a member of the board of directors of **Airtemp Div., Chrysler Corp.**, Dayton, Ohio. He had held various positions in the division since it was first moved to Dayton in 1936, most recently as assistant to the president.

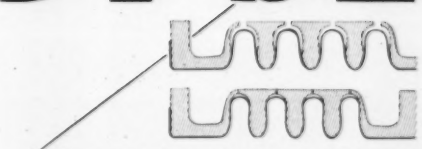
Now in charge of marketing policies, a newly created post, **John L. Busey** is a new vice president of **General Electric Co.**, Schenectady, N. Y. He has been president and a director of General Electric Supply Corp. **William V. O'Brien**, formerly general sales manager of the apparatus department, is now a commercial vice president and is assistant manager of marketing policy for the company. **Charles R. Pritchard**, former manager of marketing for the appliance and merchandise department, has been elected president and a director of **General Electric Supply Corp.** **A. K. Bushman** is managing industry divisions in the sales organization of the apparatus department. He was previously manager of the application and service engineering divisions of the department. **Harrison D. Beale** is now in charge of the renewal parts division, industrial divisions, of the apparatus department.

Before joining **Kennedy Valve Mfg. Co.**, Elmira, N. Y., in 1949, **J. Lawrence Kennedy** was vice president of Charles L. Rumrill & Co., advertising agency. He is now vice president, secretary and a member of the board of directors of the Elmira, N. Y., firm. . . . . **Westinghouse Electric Supply Co.**, New York, a wholly owned subsidiary of **Westinghouse Electric Corp.**, has elected **John F. Myers** as president to succeed **David M. Salsbury**, who has returned to the west coast for reasons of health. Mr. Salsbury is now vice president in charge of Texas and Pacific coast operations of the supply company, with headquarters in San Francisco. Mr. Myers had been managing Westinghouse Electric Corp.'s new consumer product factory branches in the middle Atlantic district.

Mead W. Batchelor, until recently executive vice president of Bridgeport Brass Co., has joined **Chase Brass & Copper Co., Inc.**, Waterbury, Conn. and is works manager of the two plants in Cleveland. The newest link in the company's chain of warehouses and sales offices is the Denver office, which was opened last month. **Charles J. McWhinnie**, formerly a salesman in the San Francisco warehouse, is managing the new branch.

At the recent annual meeting of the **American Industrial Hygiene Association**, the Cummings Memorial Lecture was presented by **Philip Drinker**, Harvard School of Public Health, who was presented with a certificate of award for outstanding contributions to the field of hygiene. The first woman to be chosen for the presidency of the association is **Anna M. Baetjer**, associate professor of physiological hygiene at Johns Hopkins School of Hygiene and Public Health. She was chosen president-elect to take office in 1951. President for 1950-51 is **Allen D. Brandt**, industrial hygiene engineer, Bethlehem Steel Co. **E. C. Barnes**, who presided at this year's conference, continues in service as past president.

D-F S-E* EXPANSION JOINTS



The importance of D-F S-E to you may be measured in dollars. Maintenance costs are reduced to a minimum. Initial cost is amortized over a long life. Case histories show BADGER D-F S-E EXPANSION JOINTS installed in the early thirties are still on the job.

D-F S-E could mean definite financial savings effected — actually D-F S-E does mean *Directed-Flexing Self-Equalizing. Directed-Flexing, an exclusive construction feature in Badger Joints, is a combination of an all-curve corrugated member and correspondingly shaped Self-Equalizing rings which not only limits the movement of each corrugation but also progressively controls each increment of movement over the area of each corrugation. This construction eliminates localized stresses which cause metal fatigue and break-downs.

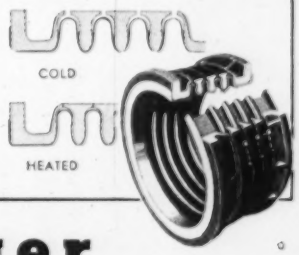
Send for your copy of Badger's new twenty-four page catalog today.

All-curve flexing guarantees longer life

Badger Joints flex like this . . .

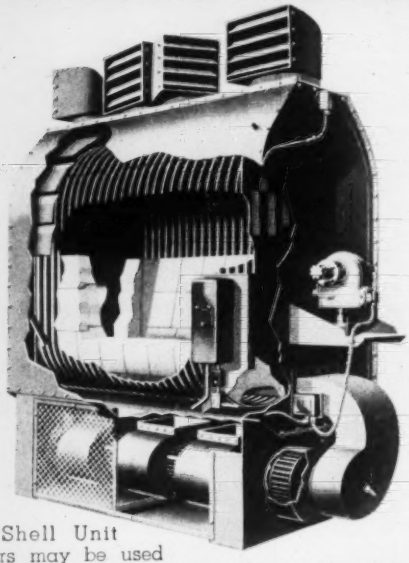
not like this . . .

. . . this stress-free flexing principle exclusive with Badger



Badger
MANUFACTURING COMPANY
230-260 BENT STREET CAMBRIDGE 41, MASS.

LEE SHELL UNIT HEATER



Lee Shell Unit Heaters may be used singly or as a central system with the heated air distributed through ducts.
The efficiency of Lee Counter-current flow reduces fuel consumption while the rugged simplicity of the system decreases cost of installation, assures low maintenance charges and provides ventilation without additional cost.

The LEE line . . .

LEE ENGINEERING CO.
95 RIVER ST. HOBOKEN, N. J.

The **Stoker Manufacturers Association** has elected the following officers for the ensuing year: president—**C. T. Burg,** president, Iron Fireman Mfg. Co.; vice president—**L. C. Dubs,** president and general manager, Canton Stoker Corp.; secretary-treasurer—**T. A. Crawford,** general manager, Timken Silent Automatic Div., Timken-Detroit Axle Co. **Marc G. Bluth** has been reappointed executive secretary. ..... **Peabody Engineering Corp.,** New York, has appointed **Allen H. Jones** as manager of its newly opened Chicago office. Although the firm maintains offices abroad, the Chicago branch is the first company operated district office in this country.

David Thomson, president of David Thomson Associates, has been elected a director of **Cyclotherm Corp.,** Oswego, N. Y. He is also a director of Derby Gas and Electric Co., New York City, Lake City Malleable Co., Inc., Cleveland, and was formerly president of Phoenix Iron Works and executive vice president of Great Lakes Steel Co. ..... **William Nelson Weinman,** president and founder of **Weinman Pump Mfg. Co.,** Columbus, Ohio, died recently after a long illness. He was 82 years of age and had been a life-long resident of Columbus where he took an active part in civic and industrial affairs.

Officers for the ensuing year of the **National Association of Fan Manufacturers, Inc.** are: president—**E. E. Trickler,** vice president, New York Blower Co.; vice president—**Edgar F. Wendt,** president, Buffalo Forge Co.; secretary-treasurer—**L. O. Monroe.** ..... A veteran of 35 years with **Westinghouse Electric Corp.,** Pittsburgh, **Louis R. Botsai** has been named manager of the motor and control division in Buffalo. He succeeds **Leon R. Ludwig,** who has been appointed a member of the staff of vice president **John K. Hodnette.**

Krantz Keller, who joined **Carrier Corp.,** Syracuse, in 1942 as a tax accountant and has been manager of the tax department since 1944, has been elected treasurer of the firm. **M. C. Aspholm,** who started with the company in 1937 as an accountant and was named head of the department of statistics and budgets in 1944, is the new comptroller. **Fred F. Hoyt** and **George N. Lilygren,** vice presidents who were also treasurer and comptroller, respectively, have recently taken on additional management responsibilities. ..... **Ralph L. Goetzenberger,** representing the **Engineers' Council for Professional Development,** has been elected chairman of the **Citizens' Federal Committee on Education,** an organization devoted to improving educational standards and practices throughout the country. He is a vice president of Minneapolis-Honeywell Regulator Co.

Jim C. Chase has been named manager of the recently expanded "DriCooler" sales department of **Marley Co., Inc.,** Kansas City, Kan. He has been located at the general offices since joining the company in 1948. ..... In his new capacity as chief engineer for **United States Air Conditioning Corp.,** Minneapolis, **Herman J. Schorle** is in complete charge of all phases of design and product engineering. He was formerly executive engineer and works manager of Worthington Pump and Machinery Corp.

Viking Air Conditioning Corp., Cleveland, has named **John S. Baker** assistant chief engineer. In his new position, he will work with furnace and air conditioning manufacturers on blower engineering problems and on the adaption of company assemblies to specific applications. ..... **Professor Theodore Baumeister,** of the **School of Engineering, Columbia University,** has been appointed to the Stevens Professorship of Mechanical Engineering. He succeeds Professors **Charles Edward Lucke** and **Harry Lilianthal Parr,** both of whom are currently Stevens Professors Emeriti at Columbia. Prof. Baumeister is well known as a specialist in power and thermodynamic problems, is a consulting engineer and is the author of a number of technical articles and books.

Ralph L. Beach, who has been serving as engineer-manager and district engineer of the southern district at Atlanta, Ga., for **York Corp.,** York, Pa., has been promoted to assistant general service manager. He has been associated with the firm since 1926. ..... **William A. Meiter** now occupies the newly created position of central sales manager for **Worthington Pump and Machinery Corp.,** Harrison, N. J. In his new position, he is directing the sales of Buffalo, Detroit, Cleveland, Cincinnati, and Pittsburgh offices. **John W. Stovall,** sales engineer in the Rochester branch, has been named manager of the Buffalo office, to which he was assigned last June.

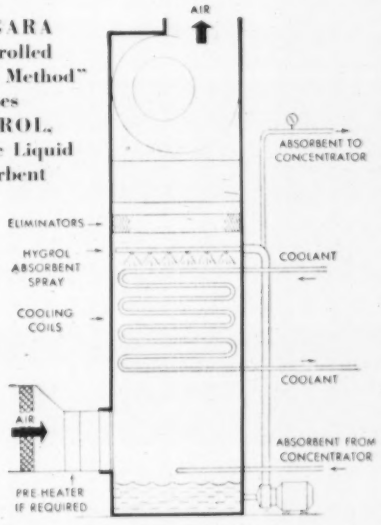
Charles J. Ramsburg, Jr., is the new manager of sales, welded products, **Spang-Chalfant Div., National Supply Co.,** Pittsburgh. He had been Pittsburgh district manager since January and now succeeds **H. G. Morrow,** who has resigned. The Pittsburgh post has been taken over by **J. K. Sutter,** Boston sales representative since 1944. .... **Manning, Maxwell & Moore, Inc.,** Bridgeport, Conn. has appointed **Erling Klafstad** assistant director of engineering for Hancock valves and Consolidated safety and relief valves. He was previously vice president in charge of engineering and manufacturing for Crosby Steam Gage and Valve Co.

Elliott R. Hallowell, former vice president in charge of engineering for Alford Refrigerated Warehouses, has become affiliated with **Snell Refrigeration Supply,** Dallas, Tex., as chief engineer. ..... **C. H. Currier,** president of Ross Heater & Mfg. Co., Inc., a division of American Radiator & Standard Sanitary Corp., has been elected president of the **Tubular Exchanger Manufacturers Association, Inc.** The new vice president is **W. C. Beekley,** president, Whitlock Mfg. Co., and **George P. Byrne, Jr.,** remains secretary-treasurer.

As the new assistant sales manager of **Ward Leonard Electric Co.,** Mount Vernon, N. Y., **W. C. Schofield,** is assisting **Frank E. Beede,** sales manager. Mr. Schofield has been associated with the company since 1948, directing sales in the industrial control division ..... Now in charge of the Boston district office of **Allis-Chalmers Mfg. Co.,** Milwaukee, is **Mert M. York.** He had been in the Charlotte, N. C. office. ..... **Melvin W. Pauly,** associated with the valve industry for over a decade, is now New York manager for **Lunkenheimer Co.,** Cincinnati.

New Method Gives Precise Control in Air Conditioning

NIAGARA "Controlled Humidity Method" Uses HYGROL, Hygienic Liquid Absorbent



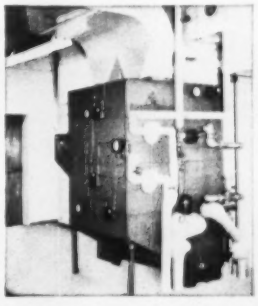
NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

● The "Niagara Controlled Humidity Method" gives complete control of temperature and relative humidity, holding constant conditions or varying them at the will of the user. Especially, it provides dry air at normal atmospheric temperatures with little or no refrigeration required.

The air is filtered and then enters a chamber where it is dehumidified in passing thru a spray of "Hygrol" Liquid (a hygienic hygroscopic chemical that absorbs the air-borne moisture and contains no salts or solids to precipitate). In the same chamber are located cooling coils which remove the latent heat of evaporation and also sensible heat as required.

The absorbent liquid spray falls into a tank at the base, where it is piped to a concentrator, removing moisture taken from the air. The re-concentrated liquid returns to the system. This process is continuous, and the apparatus operates at full capacity at all times.

This equipment is manufactured in a range of sizes providing from 1000 to 20,000 CFM of conditioned air from a single unit.



Installations have been made in food and chemical process industries, in packaging hygroscopic products, for preventing condensation of moisture on metals and other products in storage, in air conditioning for laboratory control and for human comfort.

●

For further information, write Niagara Blower Co., Dept. HP, 405 Lexington Ave., New York 17, N. Y.

Dodge Mfg. Corp., Mishawaka, Ind., has named **Kenneth Bassett** supervisor of sales promotion. He has been associated with the company for 23 years. ..... **Johnson Service Co.**, Milwaukee, has transferred the following sales personnel: **Camden G. Conaway Jr.**, from the Greensboro, N. C., branch office to the Charlotte, N. C. branch; **J. P. Patterson** from the Toronto office to Calgary, Alberta; **Robert Malcolm** from the Seattle branch to the Vancouver office; **G. L. Oswald** from Chicago to the Kansas City branch office; and **Jack Clark** from Greensboro, N. C., to the Richmond, Va., branch.

The new national sales manager for **Eutectic Welding Alloys Corp.**, New York, is **F. F. Roehll.** He joined the firm shortly after the war as a local district engineer in California and was later transferred to the New York office where he served as sales supervisor. ..... **Dr. Gerald A. Rosselot**, director of the engineering experiment station at Georgia Institute of Technology, has been elected chairman of the **Engineering College Research Council.** He will also serve as a vice president of the **American Society for Engineering Education** and he succeeds **Dean F. M. Dawson**, College of Engineering, State University of Iowa, as chairman of the Council.

The **Refrigeration & Air Conditioning Contractors Association** has selected **J. Frank Park**, of Western Air and Refrigeration, Inc., to serve as a director until the next annual meeting. **Harvey O. Miller** of Murphy & Miller, Inc., was also named a director. These men were selected to fill the positions formerly held by **E. C. Newton**, of Kelmore Refrigeration, Inc., and **A. G. Weber**, of Weber Refrigeration, who recently resigned. ..... **Combustion Engineering-Superheater, Inc.**, New York, has made a number of recent appointments. **F. J. Murphy**, formerly production manager of the Chattanooga division, is now general purchasing agent and **B. A. Anderson** is the new production manager. **Myron F. Freeman** is managing the service and erection department.

Charles L. Haslup, well known in the valve industry for many years, was recently appointed sales manager of the **R-P&C Valve Div., American Chain & Cable Co., Inc.**, Reading, Pa. ..... After 31 years of service, **Fred G. Berling**, advertising manager for **Lunkenheimer Co.**, Cincinnati, has retired. He joined the organization as a buyer in the purchasing department. With his retirement, the functions of the advertising department are being consolidated with the sales department and some are being transferred to the company's advertising agency.

W. C. Schneider, Ken Stevens, Lillian Smith, and **Angus Cameron**, all of the Boston office of **Preferred Utilities Mfg. Corp.**, New York, recently celebrated the 25th birthday of the branch office. ..... **Robert L. Smith** and **Fred A. Dathe** are new sales engineers for **Kaylo Div., Owens-Illinois Glass Co.**, Toledo. Mr. Smith has been assigned to the Cincinnati territory and Mr. Dathe will assist **J. D. Hailey**, working from the company's general office in Toledo and covering a territory which includes northern Ohio and Indiana and the entire state of Michigan.

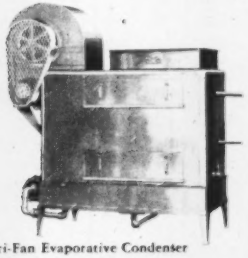
RECOLD

Recold Air Conditioning Equipment Provides All The Features You Want Plus The Performance You Need!

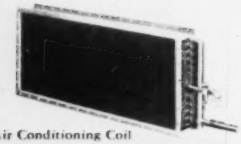
Dependable engineering and precision manufacturing are embodied in all Recold air conditioning equipment. Unusual features of design and improved engineering techniques have made Recold equipment widely accepted for all air conditioning applications. The Recold trade-mark on equipment that you buy or specify is your assurance that it will fulfill the requirements called for in the job specifications. Write or wire today for complete engineering information.

Vertical Air Conditioner

Horizontal Air Conditioner



Dri-Fan Evaporative Condenser



Air Conditioning Coil

Refrigeration ENGINEERING, INC.

7250 East Slauson Avenue Los Angeles 22, California

Frederick C. Dressel has been appointed assistant to the president of **Economy Gas Furnace Mfg. Co.**, Chicago. He was formerly in the investment banking business and more recently was assistant to the president of Salerno-Megowen Biscuit Co. ..... **Allen P. Beckloff** is now manager of the tubular products division of **Joseph T. Ryerson & Son, Inc.**, Chicago. He had been manager of the tubular products department of the company's plant in Cleveland and now succeeds **R. W. Burt**, who was recently appointed Chicago plant sales manager.

With headquarters in New York City, **Clifford Wood** is now managing the eastern division of **Catawissa Valve & Fittings Co.**, Catawissa, Pa. Before joining the firm, he was sales manager of Jefferson Union Co. for several years ..... **United States Stoneware Co.**, Akron, Ohio, has named **G. W. Fine** as assistant sales manager for its plastic coatings division. He had been associated with Sherwin Williams Co. for seven years.

John C. Abram, formerly with George F. Hartman Engineering Co., has joined the staff of the blower division of **Aladdin Heating Corp.**, Oakland, Calif. . . . **H. L. MacElroy** is now managing the Chicago office of **Springfield Boiler Co.**, Springfield, Ill. He has had more than 20 years of experience in the steam generating and fuel burning fields. **Seltzer & Co., Inc.**, 805 Beacon St., Boston, is handling representation in that area and **Krewasco Corp.**, 252 Mt. Hope Ave., Rochester, N. Y., is covering western New York state.

Thomas V. McCauley is now a "Janitrol" sales engineer in the Kansas City territory of **Surface Combustion Corp.**, Toledo. He had been a sales representative for Brown & Bigelow Co. in Kansas City. **Wilson W. Morrow** is a new sales representative in the Albany, N. Y., and Fairfield County, Conn., territory of the company. Mr. Morrow was previously associated with Stevens & Equi Co. in the position of sales manager and with Hardy Trading Export Co. as eastern representative.

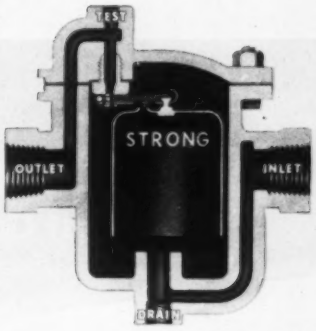
Industrial Sales & Engineering Co., Memphis, Tenn., is handling sales representation in that area for **Swartwout Co.**, Cleveland, Ohio. **C. W. Dean** and **R. E. Overman** will supervise sales of Swartwout power plant equipment. **Albuquerque Engineering Co.**, Albuquerque, N. M., is also a new power plant representative. **C. E. Barnhart**, of the Albuquerque firm which also handles Swartwout ventilating equipment, is in charge of steam specialty sales.

Tomas S. Agramonte, manufacturers' agent with offices in the Pan American Airways Bldg., Havana, has been appointed representative for **E. F. Drew & Co., Inc., Power Chemicals Div.**, in Cuba. He is representing the New York firm in the sale of its evaporator treatment and boiler water treatment. ..... **Kenneth L. Lamm** is now a member of the engineering department of **Timken Silent Automatic Div., Timken-Detroit Axle Co.**, Jackson, Mich. Following his graduation from the University of Wisconsin with a bachelor's degree in mechanical engineering, he obtained a master's degree at the University of Illinois and has recently done research and test work in various phases of heating.

Get this *SMALL* TRAP

With

BIG TRAP quality features!



- Renewable seat—easily removed for servicing.
- Strong's patented, wear-resistant Anum-Melt† valve and seat—guaranteed leak-proof for one year. Scientifically designed Hi-Cap* orifice gives greater capacity.
- Oversized ports—increased capacity.
- Horizontal inline connections—simplifies piping.
- Stainless 18-8 high ratio leverage.
- Large gasket area.
- Seamless, deep drawn, stainless 18-8 bucket—no welds.
- Bottom drain or inlet connection.

Available for pressures from 0 to 150 p.s.i., the Strong* No. 070 fits all standard trap applications. Built especially for use on laundry, restaurant and hospital equipment and in industry wherever small drainage is a problem.

As with all Strong Semi-Steel Traps, the 070 is guaranteed against defects in material and workmanship for one year. Write today for Catalog 68-H.

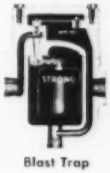
*U. S. Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd Street
Cleveland 13, Ohio

†Anum-Melt

Reducing Valve


Blast Trap

Strainer

STRONG

FIN-TUBE
Radiant Coils

Heat from the ceiling...or from walls

☆

Kritzer Radiant Coils heat the air in the joist or stud spaces so that ceilings, walls or floors *become* radiant panels of uniform warmth essential to good heating. Concealed by, but not imbedded in the building materials, they are not subject to the limitations of other systems . . . can be completed and tested without help from other trades. Thousands of installations prove that Kritzer Radiant Coils provide all the advantages of radiant panel heating at lower labor and material costs.

Kritzer Fin-Tube Radiant Coil installations save time, labor and money. Installation is begun and finished as soon as framing is completed and before plastering is started. Because a single Kritzer Radiant Coil supplants many lengths of ordinary tubing, the labor for suspension and joining is drastically reduced.

GET THE FACTS

The construction of a Kritzer Radiant Coil is simple, yet unusually effective. Collared aluminum fins are mechanically bonded to a single copper tube and arranged in sections for a highly multiplied heat transfer surface.

Photograph of typical inside wall panel installation

KRITZER RADIANT COILS, INC.
2905 WEST LAWRENCE AVENUE, CHICAGO 25, ILL.
Gentlemen: Send me literature on Kritzer Fin-Tube Coils.

Name

Firm

Address

City Zone State

"IF IT'S KRITZER, IT'S RIGHT, SIR!"

NEW BOOKS & REPORTS

Recommends Symbols for Process Instrumentation

ISA Tentative Recommended Practice RP5.1, Instrumentation Flow Plan Symbols, is a report prepared by the Instrument Society of America to promote a uniformity of practice that will simplify and expedite instrumentation work. The system presented for designating and identifying instrumentation on flow plans is recommended for use in specifications, listings, requisitions, order sheets, on piping and other construction drawings, for identification tagging of equipment, and for use in technical and trade literature.

According to the Society, the system of symbols and identification is the result of an extensive survey of the subject. It is a consolidation of ideas and usual practice in systems now being used. A sub-committee first drafted a suggested system and this, with a questionnaire, was sent to 352 individuals and organizations.

While the instrumentation symbols and identifications presented are suited primarily to the needs of the industrial process industries, the system should be adequate for allied industries such as steam generation, fluid materials, air conditioning, etc.

Copies of the report are available from ISA headquarters, 921 Ridge Ave., Pittsburgh 12, for $1.00. Quantity discounts are offered.

More Difficult Methods, Details Added to Heat Transfer Text

The second edition of Elements of Heat Transfer and Insulation, by Max Jakob, research professor of mechanical engineering, Illinois Institute of Technology, and George A. Hawkins, Westinghouse research professor of heat transfer, Purdue University, is now off the press. Like the first edition, it has been prepared for use in courses of study at the undergraduate level and its contents have been confined to fundamental facts. However, the new edition includes some slightly more difficult methods and details.

At the end of the section on heat transfer from a rod heated at one end, it was merely mentioned in the first edition that the equations derived hold also for fins. Now, a detailed section on heat transfer from fins is included. Similarly, when dealing with the log mean temperature difference in heat exchangers, it was formerly indicated that for complex types of heat exchangers correction factors had been worked out. Now, graphs for shell and tube exchangers with different numbers of passes are included in order to give the student an idea of how such items are handled in practice. Instead of restricting the treatment of steady-state conduction to the simple cases of infinitely wide plane plates and infinitely long cylinders, two sections have been added, one dealing with the conduction on edges and corners of walls, the other dealing with pieces of more complicated shape. Other important changes include the addition of a table of nominal sizes of tubes, the revision of the section on periodical change of surface temperature, and the addition of a section on heat transfer and fluid friction on plane surfaces.

Possibly the largest expansion has been given to the

chapter on radiation. Use has been made of Hottel's results in geometry radiation by including tables and graphs of configuration factors for surfaces, parallel or rectangular to each other, and by dealing in some detail with the radiation exchange between black and gray radiators in the presence of re-radiating surfaces, as needed in the practice of furnace design.

The second edition of this cloth bound text (230 + xvi pages, 6 × 9 in.) is published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, and is priced at $4.00.

Poor Sealing of Steam Safety Valves Caused by Tiny Leaks

The methods of popping and closing safety valves are well understood. However, the problem of leakage of safety valves, particularly for high pressure steam, has long been recognized by designers as one of the most difficult problems to be overcome. According to R. E. Adams, research engineer, Battelle Memorial Institute, and J. L. Corcoran, chief engineer, Consolidated Safety Valve Div., Manning, Maxwell & Moore, Inc., poor sealing is a result of self-induced growth of tiny initial leaks. Expansion of the leaking steam cools local areas of the valve seat, causing contraction of the seating surfaces in a manner which increases the size of the leak.

Sealing of High Pressure Steam Safety Valves is a report of an investigation conducted by these two men, who have developed a new design of valve seat incorporating thin flexible seating surfaces. The cooling effects of the leaking steam are minimized by providing better heat transfer from the high temperature steam. According to the report, the new design results in considerable improvement in sealing, and service tests have shown excellent performance.

Paper No. 50-S-24 was presented at the spring meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

Gives Data on Titanium Alloys

A research report, prepared by P. R. Mallory Co., Indianapolis, for the Navy's Bureau of Aeronautics, covers the 5 percent chromium, 3 percent aluminum, titanium alloy recently described by the Navy as having the strength of high-strength steel with about half its weight.

Among the tabulated results given in the report are the effects of the following constituents in titanium alloys: carbon; copper; manganese and silicon, alone and in combination. Aluminum, chromium and carbon are described as forming "strong, ductile, highly electrical resistance alloys" with titanium. Alloys of either chromium or aluminum alone are said to have little or no ductility, but show improved hardness at elevated temperatures. The report describes in detail the melting furnace; the preparation of charges, and the fabrication of ingots.

PB 100,000, The Manufacture of Titanium Alloys, is a 108 page report including graphs, tables and photographs and is available at $4.50 in microfilm, $13.75 in photostat form, from the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C. Checks or money orders should be made payable to the Librarian of Congress.

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Fig. 302

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Finds Critical Effective Temperature Region for Performance of Work

Effective temperatures of 83 to 87.5 F, when the air movement is 100 fpm, represent a critical region above which most acclimatized men dressed in shorts will not work effectively indoors. This conclusion applies to all forms of intensive work, both physical and mental. The accuracy of highly skilled men is not affected as much as that of less skilled men by high atmospheric temperatures, because skilled men require less effort to complete a given task. However, when the amount of work done is the criterion of efficiency and output is unrestricted, it is the men who are putting the greatest effort into doing the work who deteriorate most in hot atmospheres.

These are some of the conclusions of N. H. Mackworth, as stated in his paper, Researches on the Measurement of Human Performance. His report is the result of an investigation of the effects of certain harassing gases and of extremes of heat and humidity. Below this critical level, considerable and easily distinguishable variations of heat and humidity produced very little corresponding change in performance and, according to the author, it is possible to show that the direct measurement of work achieved was a better indicator of change of ability than any known physiological criterion.

Identified as a Special Report No. 268 of the British Medical Research Council, the 156 page, paper covered booklet is published by His Majesty's Stationery Office, P. O. Box 569 London, S. E. 1, England. The price is four shillings net. Copies may be ordered from the British Information Services, 30 Rockefeller Plaza, New York 20.

Summarizes Legal Aspects of Industrial Hygiene Codes and Air Pollution Regulations

A report summarizing legislative developments of workmen's compensation, state industrial hygiene codes, air pollution regulations, and trends in health and sickness disability benefits has been prepared by the Industrial Hygiene Foundation, 4400 Fifth Ave., Pittsburgh 13.

The 50 page bulletin contains material presented in connection with the foundation's last annual meeting and includes a discussion of industrial noise effects and reduction by Dr. Leo G. Doerfler, University of Pittsburgh. Other articles and authors are: Legislative Developments in Workmen's Compensation During 1949, by Theodore C. Waters, Mullikin, Stockbridge & Waters; Hygienic Standards for the Prevention and Control of Occupational Diseases, by J. J. Bloomfield, division of industrial hygiene, U. S. Public Health Service; Legislation Relating to the Control of Air Pollution, by R. F. Hansen, general chemical division, Allied Chemical & Dye Corp.; and Current Trends Relating to Health and Sickness Disability Benefits, by Dr. John J. Wittmer, Consolidated Edison Co. of New York.

Copies of the paper covered report, Transactions Bulletin No. 12, may be obtained from foundation headquarters.

Other Books and Reports Received

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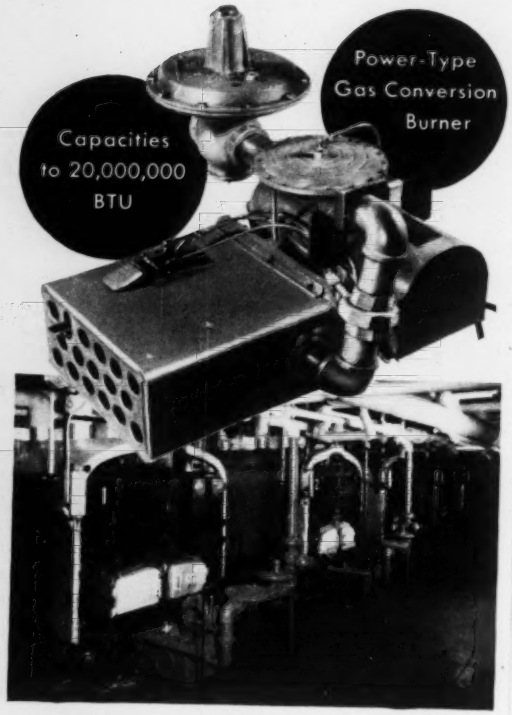

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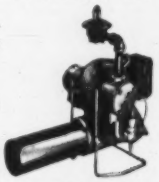

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relating to stainless steel, wrought iron, and metallic coated sheets are also given. Containing 204 pages and paper covered, the booklet may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, for $2.25.

Coal, by Dr. Harold J. Rose, vice president and director of research, Bituminous Coal Research, Inc., a concise, authoritative survey in usable form—Contains information on various phases of the origin, production, testing and use of coal. The 134 page paper covered booklet is available from BCR Headquarters, 2609 First National Bank Bldg., Pittsburgh 22, for $1.00. The material in the booklet is reprinted from the Encyclopedia of Chemical Technology.

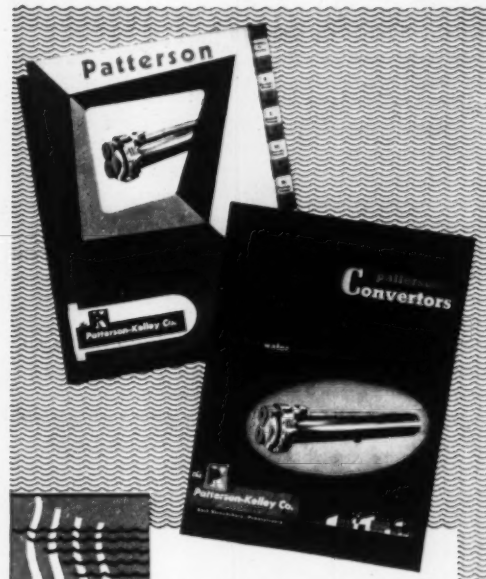
Management of Industrial Research, a selected and annotated bibliography—published by Arthur D. Little, Inc., Cambridge 42, Mass. This 14 page booklet contains a selected bibliography of books and articles on management of industrial research. It is available at no charge.

Weather and the Building Industry—The First Research Correlation Conference. In the form of a 160 page, paper covered book, the Proceedings of the conference contain papers which provide a summary of what is known about climatology and its relation to the building industry. In addition to papers covering recent climatological data, others deal with the development of weather sciences for better use in the building industry and the relation of climate to the structure, to building design, and to indoor comfort. Two of the papers (one by John Everetts, Jr., of the office of Charles S. Leopold, consulting engineer, and the other by C. M. Humphreys, G. V. Parmelee, and Cyril Tasker, all of the ASHVE Research Laboratory) were briefly summarized on page 230 of the May issue of HPAC.

BRAB Conference Report No. 1 was prepared by the Building Research Advisory Board, Div. of Engineering and Industrial Research, National Research Council, Washington 25, D. C.

Warm Air Heating Library, published by the National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14, priced at $8.00—This volume contains the association's Manuals 1 through 9, copies of the work sheets, and samples of the promotional material prepared by the association. Also included are articles on various phases of warm air heating problems and applications.

Gray Finishes for Industrial Apparatus and Equipment (ASA Z55.1-1950) is a new standard which is said to be the result of unified efforts of industry to reduce the number of colors for industrial apparatus, machines, and equipment. According to the American Standards Association, 70 E. 45th St., New York 17, these standard grays represent the consensus reached by 18 organizations and groups which represent all classes of manufacturers and users of equipment. Copies of the standard are available at 35 cents from ASA Headquarters. Four color chips are offered for $2.25 and when the chips and the standard are purchased together, the price is $2.50.



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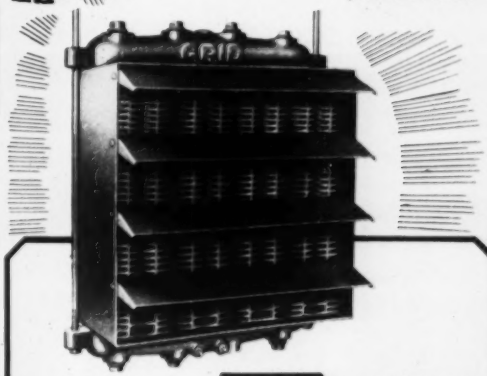

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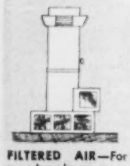

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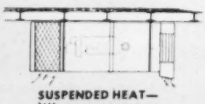

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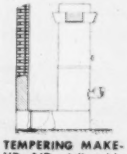

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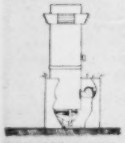

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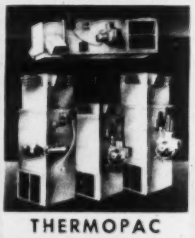

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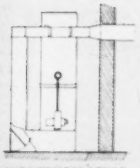

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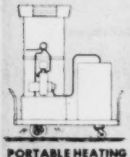

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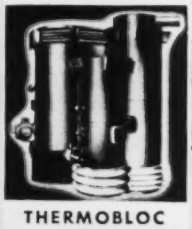

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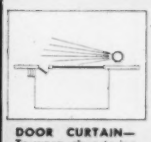

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MEETINGS & CONVENTIONS

First United States International Trade Fair—August 7 to 20, Chicago. Exhibits are classified under 29 categories, including both industrial and consumer commodities, and include displays of heating, ventilating, and air conditioning equipment.

National Power Show, sponsored by the National Association of Power Engineers, 176 W. Adams St., Chicago—The 49th annual show and the 67th annual convention of the association will be held August 15 through 19, Hotel Jefferson, St. Louis.

Among the speakers will be Raymond R. Tucker, professor of mechanical engineering, Washington University, and former smoke commissioner of the city of St. Louis. His talk will deal with problems encountered and advancement made in controlling air pollution and fly ash in and around St. Louis.

I-B-R Heating School—Begun in Springfield, Mass., in April and sponsored by the Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17, a traveling school is designed to provide an intensive three-day training in heating design and installation. The instructor is Arthur L. Wales, field training director for the institute, and the tuition fee is $18.00. Classes will be held this month in Pittsburgh and Cincinnati, and next month in Cleveland, Detroit, Milwaukee, and Minneapolis.

Sixth National Chemical Exposition, sponsored by the Chicago section of the American Chemical Society, 86 E. Randolph St., Chicago 1—To be held September 5 to 9, Chicago Coliseum. The show will be held concurrently with the national meeting of the American Chemical Society.

A feature of the show will be a demonstration of an instrument for producing ultra high frequency sound waves. The demonstration will include emulsification of oil and water, stimulation or destruction of bacteria, vaporization of liquids, and mixing paints.

Instrument Conference and Exhibit—Sponsored by the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12, the 1950 Instrument Conference and Exhibit will be held in the War Memorial Auditorium, Buffalo, N. Y., from September 18 to 22. This will be the fifth national conference and exhibit of the Society.

The 1951 conference and exhibit will be held September 10 to 14, at the Coliseum, Houston, Tex.

American Society of Mechanical Engineers, 29 W. 39th St., New York City—The fall meeting is scheduled for September 19 to 21, Hotel Sheraton, Worcester, Mass., and the annual meeting will be held November 26 to December 1, Hotel Statler, New York City.

Corrosion Short Course, sponsored by the National Association of Corrosion Engineers and scheduled for September 25 to 29 at Case Institute of Technology, Cleveland. Nine 2 to 2½ hr lecture periods with time for discussions are planned, and the course is designed

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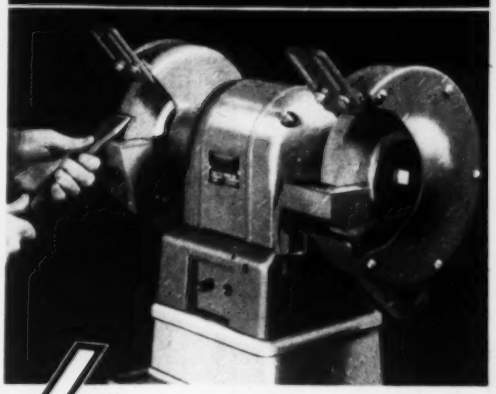

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as a refresher for those actively engaged in corrosion prevention but will not be too advanced for those just entering the field. Housing is available in a hotel adjacent to the campus and meals will be served in the college cafeteria. Further information and application blanks may be obtained from Dr. R. B. Hoxeng at Case Institute.

American Gas Association, 420 Lexington Ave., New York 17—The 1950 annual convention will be held October 2 to 6, Atlantic City. Haddon Hall has been designated as headquarters for the accounting section; the Ritz Carlton hotel will be headquarters for the residential gas section and the industrial and commercial section; and the Dennis hotel will be headquarters for the operating section.

The 38th National Safety Congress and Exposition, October 16 to 20, Chicago—Sessions on industrial safety will be held in the Stevens, Morrison, and Congress hotels. Additional information may be obtained from R. L. Forney, general secretary, National Safety Council, 425 N. Michigan Ave., Chicago 11.

Refrigeration & Air Conditioning Contractors Association, 228 N. La Salle St., Chicago 1—The 5th annual convention will be held November 15 and 16 at the Hotel Lafayette, Long Beach, Calif. The affair will be held to coincide witth the west coast refrigeration and air conditioning conference and exhibit.

Refrigeration and Air Conditioning Conference and Exhibit, sponsored jointly by the Refrigeration Equipment Manufacturers Association and the Refrigeration Service Engineers Society—The remaining three conferences in a series of four will be held November 17 to 19, Municipal Auditorium, Long Beach, Calif.; January 26 to 28, State Fair Grounds, Dallas; April 6 to 8, Hotel Statler, Buffalo.

Additional information may be obtained from the REMA public relations department, 1346 Connecticut Ave., N.W., Washington 6, D. C.

Refrigeration Service Engineers Society, 433 N. Waller Ave., Chicago—The 13th annual meeting, November 17 through 19, Long Beach, Calif.

19th National Exposition of Power and Mechanical Engineering, November 27 to December 2, Grand Central Palace, New York City—The show will be held in conjunction with the annual meeting of the American Society of Mechanical Engineers and, for the first time, will be under the auspices of the society. Show management is being handled by International Exposition Co., Grand Central Palace, New York.

American Society of Refrigerating Engineers, 40 W. 40th St., New York 18—The 45th annual meeting will be held December 3 to 6, New York City.

National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14—The 37th annual convention, December 5 and 6, Hotel Statler, St. Louis.

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Completely engineered

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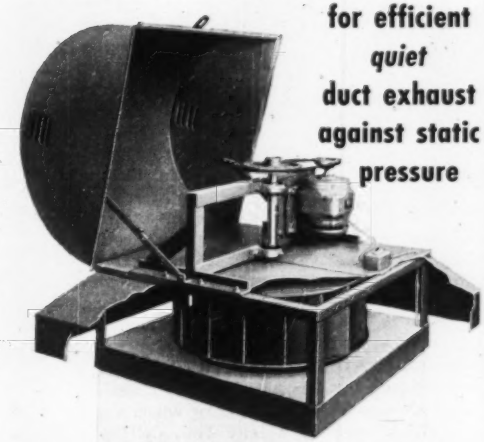

This new duct exhaust ventilator brings you the quiet ventilation you've wanted for offices, schools, recreation halls and other applications. Airlift is powered by an unusually efficient centrifugal type fan unit having a streamlined inlet. Other structural features maintain Airlift's air moving effectiveness while operating at *very low noise levels.*

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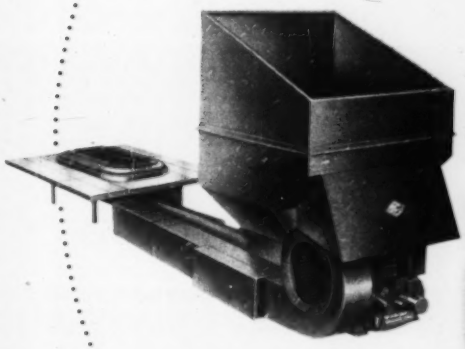

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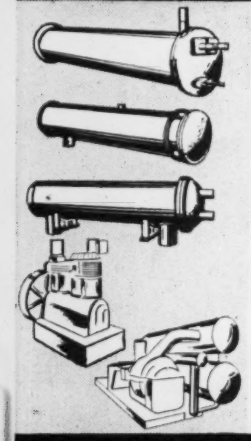

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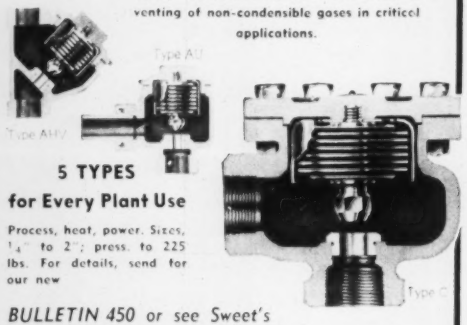

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For your convenience in obtaining copies of these bulletins, see coupon on page 169. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

HPAC 101—AIR MOTORS AND GAS PUMPS—Catalog 450, Leiman Bros., Inc., 210-F Christie St., Newark, N. J., contains performance curves and specification tables on its four-wing type and two-wing type air pumps and accessories. The air pumps are of the rotary positive type, designed for producing vacuums up to 29 in. and pressures up to 25 psi. A section of the catalog deals with air motors, which are simply air pumps operating in reverse with compressed air as the power source.

HPAC 102—ARC WELDING—Lincoln Electric Co., Cleveland 1, Ohio, has issued a catalog sheet on its 200 amp "Fleetwelder". Featuring an exclusive "Arc-Booster" this a-c machine is rated at 200 amp at 30 volts and 50 percent duty cycle. Also available from the company is bulletin 467, a directory of welding supplies which includes electrode holders, wire brushes, connectors, ground clamps, cable lugs, protective shields, welding cable, etc.

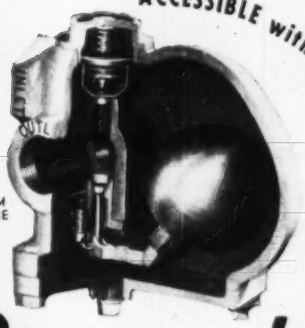
HPAC 103—BENDING, FABRICATING PIPE—Wallace Supplies Mfg. Co., Inc., 1300 Diversey Parkway, Chicago 14, has released a 60 page catalog which also covers its subsidiary companies: Wallace Tube Co. Div., Alloy Tubes Co. Div., and Welded Truck & Specialty Co. Div. Products covered include a variety of bending machines, electric swing saws, high speed metal cutoff saws, shears and cutters, stainless steel pipe and tubing, fabricating tools, valves, and wrenches. Also described are fabricating facilities.

HPAC 104—COPPER-STAINLESS STEEL SHEETS—A new booklet which explains "Rosslyn" metal in non-technical language is available from American Cladmetals Co., P. O. Box 544, Carnegie, Pa. The metal is made in sheet form with copper sandwiched between surface layers of stainless steel, the metals bonded together by means of the Kinney process which is owned by the company. The metal is said to provide the high heat conductivity of copper and the hardness and corrosion resistance of stainless steel.

HPAC 105—DEHUMIDIFIER—Abbeon Supply Co., 58-10 41st Dr., Woodside, New York City, is offering a four page folder on a refrigeration type dehumidifying unit designed to serve a space of about 13,500 cu ft. The hermetic compressor unit is of 1 5 hp and the fan motor is 1 40 hp. Also included is a discussion of some facts about dehumidification.

HPAC 106—DIRECT CURRENT MOTORS—Bulletin C-2001 of Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland 10, covers d-c motors from 3/4 to 1000 hp. Motors described include drip-proof, splashproof, totally enclosed, explosionproof, blower ventilated, and

ACCESSIBLE without disconnecting



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HPAC 107—DIRECT FIRED AIR HEATERS—Bulletin 802 of Airtherm Mfg. Co., 711 S. Spring Ave., St. Louis 10, describes and illustrates direct fired air heaters designed for gas or oil firing and available in horizontal and inverted suspension models. Features of the various units are described, capacity tables are included, and typical installations are shown.

HPAC 108—EVAPORATIVE COOLERS—Essick Mfg. Co., 1950 Santa Fe Ave., Los Angeles 21, is offering 18 models of evaporative coolers from single room window mounted units to the larger commercial and industrial models utilizing centrifugal blowers. They are briefly described and illustrated in a new bulletin.

HPAC 109—FANS AND BLOWERS—Schwitzer-Cummins Co., 1125 Massachusetts Ave., Indianapolis 7, has prepared a four page folder on its line of ventilating products, including attic fans, window fans, cabinet fans, portable fans, exhaust fans, and centrifugal blowers of both single and double inlet types. Features of design and construction, capacities, dimensions, motor sizes, etc., are briefly covered.

HPAC 110—FUEL OIL TREATMENT—"Sabanol" is designed to disperse sludge and water in fuel oil by colloidal homogenization of sludge and emulsification of water. It is also said to soften and disintegrate any adhering existing sludge. According to the manufacturer, it is a neutral, concentrated liquid fuel oil treatment which contains an exclusive soot retardant and rust inhibitor. It is described in a folder issued by American Sand-Banum Co., Inc., 9 Rockefeller Plaza, New York 20.

HPAC 111—HEAT TRANSFER UNITS—Patterson-Kelley Co., Inc., 15 Wilson Ave., East Stroudsburg, Pa., has issued a 12 page catalog (No. 303) describing its "D" line of convertors designed especially for use with hot water heating systems. In these convertors, steam enters the shell and condenses, transferring its heat to the water flowing through the U tubes. According to the manufacturer, the design of the tube bundle is such that each tube can expand and contract independently of the others.

HPAC 112—METALLIZING—In a new bulletin, Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N. Y., describes its new "Metco" system for corrosion prevention. Zinc or aluminum is applied directly to a steel base with standard metallizing equipment, in order to prevent rust on tanks, bridges, pilings, refrigeration equipment, fabricated steel products, etc. Bulletin 93 briefly describes the company's systems.

HPAC 113—MULTIPLE V DRIVES—Information on its line of multiple v drives, including "Ful-Grip" sheaves and "Mor-Grip" multiple v belts, is available in bulletin MVD-1000, a 16 page booklet published by Maurey Mfg. Corp., 2915 S. Wabash Ave., Chicago 16.

HPAC 114—NICKEL ALLOYS—Two new technical bulletins on the properties of high nickel alloys have been

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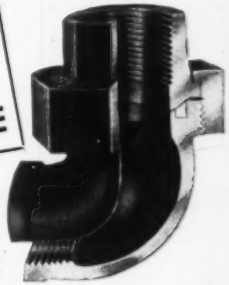

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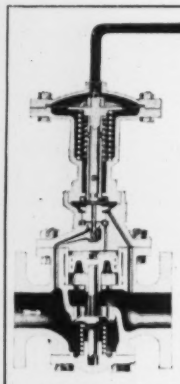

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issued by International Nickel Co., Inc., 67 Wall St., New York 5. Both are 24 pages in length and contain charts and tables on compositions and properties, working instructions, and other information of a technical nature. Bulletin T-7 covers engineering properties of inconel and bulletin T-9 deals with properties of monel.

HPAC 115—OIL AND REFRIGERANT MIXTURES—The May issue of the house organ published by Ansul Chemical Co., Marinette, Wis., features a new report on the properties of oil and refrigerant mixtures. Prepared by Walter O. Walker, director of research, the report features a number of charts showing wax separation, viscosity change, and pour point curves for various mixtures of different refrigerants and oil. Temperature is plotted against percent of oil in refrigerants and the refrigerants covered include methyl chloride, sulphur dioxide, and "Freon-11".

HPAC 116—OIL VISCOSITY—In the Vol. 36, No. 6 issue of the house organ published by The Texas Co., 135 E. 42nd St., New York 17, is included a discussion of oil viscosity which was begun in the previous issue. Some of the topics covered include turbulence, effects of temperature and pressure, the viscosity index system, and plasticity.

HPAC 117—OXYACETYLENE WELDING—Articles which are contained in the July issue of the house organ published by Linde Air Products Co., Unit of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, include hints for making corner welds with the oxyacetylene torch, a chart for the selection of a hard facing rod, and a description of a method for annealing aluminum sheet with the use of an oxyacetylene flame.

HPAC 118—PACKLESS EXPANSION JOINTS—Bulletin R-35-51 explains the design and construction of "Corruflex" corrugated packless expansion joints offered by American District Steam Co., North Tonawanda, N. Y. Selection charts are shown and descriptive material covers sizes, temperature and pressure ratings, dimensions, and weights.

HPAC 119—PIPE FITTINGS—Kennedy Valve Mfg. Co., Elmira, N. Y., offers bulletin 104 on its line of cast iron, malleable, and bronze pipe fittings. The booklet describes recent additions of cast iron screwed, flanged, sprinkler and extra heavy malleable fittings to the line.

HPAC 120—PREFABRICATED DUCT FITTINGS—Prepared especially for warm air heating, ventilating, and air conditioning contractors and dealers, a new 8 page brochure describes profit producing advantages and money saving features of standardized fittings. It has been issued by Air Distribution Institute, 2130 Keith Bldg., Cleveland 14, an organization representing some 17 producers of prefabricated duct fittings. The booklet tells how these fittings help eliminate shop variables, hidden overhead costs, job delays, and installation interruptions.

HPAC 121—PUMP CONTROLS—"Autocon Mototrols" are pressure operated pump controls designed for use with elevated tank systems. They are installed at the pump site

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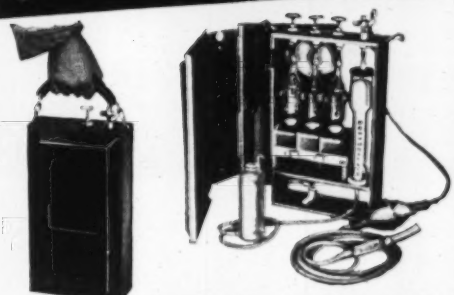

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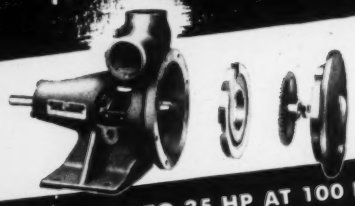

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and are designed to automatically operate pumps by means of pressure changes at predetermined high or low tank levels. One bellows is used for high level control and one bellows for low level control. The sequence of operation is described and illustrated and design and construction features are covered in a new bulletin issued by Automatic Control Co., St. Paul 4, Minn.

HPAC 122—RECORDING THERMOMETERS—Bristol Co., Waterbury 20, Conn., has published a 44 page bulletin (No. T840) giving complete information on its series 500 line of thermometers. Liquid filled, vapor pressure, and gas filled types are described in models for recording, indicating, controlling and telemetering of temperatures. Information is given on operating principles, characteristics of operation, temperature sensitive bulbs, recording charts, and accessories. Resistance types of thermometers, humidity instruments, and time-temperature controllers are also described.

HPAC 123—RED WATER TREATMENT—Red water or iron water, resulting from oxidation and precipitation of iron in the water, and black water, caused by manganese, frequently induce fouling of water lines and equipment, staining of textiles, off-color dye shades, etc., according to Calgon, Inc., Hagan Bldg. Pittsburgh 30. An effective, low cost solution is said to be the company's "threshold treatment" whereby minute amounts of "Calgon" are continuously fed into the water stream before the iron or manganese present can precipitate. The treatment is described and illustrated in a new folder.

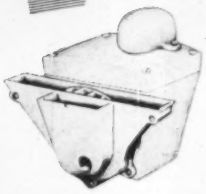
HPAC 124—REFRIGERATION HEAT INTERCHANGERS—Available in capacities from 15 to 100 tons, heat interchangers for subcooling liquid refrigerants are briefly described and illustrated in a new leaflet prepared by Heat-X-Changer, Inc., Brewster, N. Y. Units feature longitudinal fins on both suction line and liquid line. Also released by the company are a condensed data sheet on remote air and water cooled combination condensers and a price list (No. 102) covering liquid coolers, counterflow condensers, water cooled condensers, tube cleaners, heat interchangers and shell and coil equipment.

HPAC 125—REFRIGERATION VALVES, SPECIALTIES—Ammonia shutoff and line valves, together with all-steel gage sets (for ammonia "Freon," or methyl chloride), all-steel purge valves and needle point valves, relief valves for ammonia and "Freon", three-way valves, dehydrators and liquid line strainers are described and illustrated in a new catalog issued by Cyrus Shank Co., 625 W. Jackson Blvd., Chicago 6.

HPAC 126—REGISTERS AND GRILLES—Catalog No. 50 has been released by Independent Register Co., 3747 E. 93rd St., Cleveland 5. The 36 page booklet includes selection tables and weights, together with data on open areas, sizes, and prices. The company's complete line of grilles, cold air faces and registers is covered.

HPAC 127—SELF TAPPING SCREWS—A new 48 page bulletin on self tapping screws is available from Parker-Kalon Corp., 200 Varick St., New York 14. Identified as

2 LITTLE GIANTS



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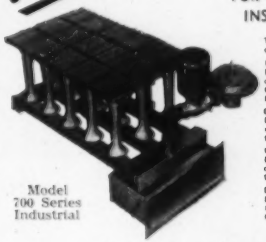

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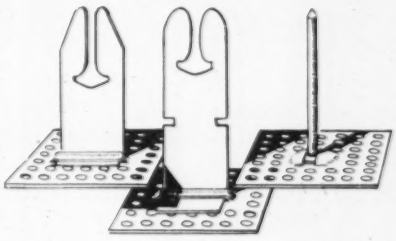

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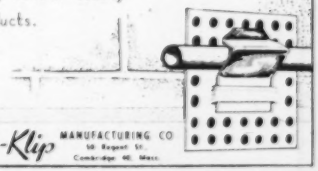

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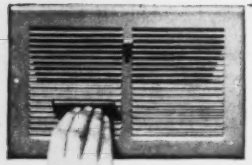

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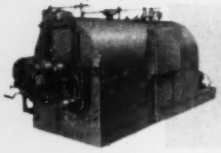

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Form 430, the booklet contains a description of the various types of screws, shows many examples of their use, and gives detailed application information. Recommendations are made for using these screws in light and heavy gage sheet metal, nonferrous castings, metal forgings, plastics, resin impregnated plywood, asbestos compositions, etc. Modern assembly methods and various screw driving devices are described and illustrated.

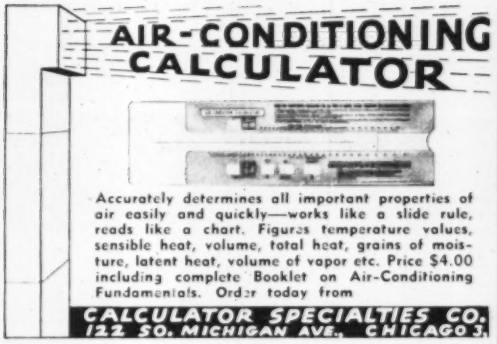
HAC 128—SHAFT SEALS—"Flexo-Seals" are now standard equipment on enclosed type ammonia, "Freon 12" and booster compressors of Frick Co., Inc., Waynesboro, Pa. According to the company, these seals prevent either leakage or overheating where the shaft extends through the housing of an enclosed type refrigerating machine. The seals are covered in a new folder.

HPAC 129—SLUDGE CONTACT REACTORS—Publication 5001 of Cochrane Corp., Philadelphia 32, Pa., covers the new sludge contact reactors designed for such services as clarification of surface water; lime or lime-soda softening of any hard water; clarification and or softening surface and well waters; coagulation and reduction of alkalinity; removal of silica; removal of fluorides; iron and manganese removal; separation of fiber stock, etc. Leading off with a discussion of the basic principle utilized, the booklet describes how the reactors operate, covers types available, and describes numerous applications.

HPAC 130—STAINLESS STEEL FILTERS—Using diagrams, tables, and catalog data, Micro Metallic Corp., 193 Bradford St., Brooklyn, N. Y., has prepared an eight page booklet on the advantages, uses, operation and manufacturing methods of "Surfamax" filters. A listing is given on the water flow and air flow characteristics of these porous, stainless steel filters. Types of filters and their arrangements for various requirements are covered, together with detailed information on dimensions and specifications. Also dealt with are advantages of these filters for large operations and the type of applications in which "Gravitain" filters are used. The filters, with porous stainless steel elements, are recommended for numerous industrial pipe line applications.

HPAC 131—STEAM INJECTION HEATERS—A four page bulletin, available from Pick Mfg. Co., West Bend, Wis., describes and illustrates instantaneous steam injection heaters and includes a cost-check table giving comparisons of different heating methods. Advantages are said to include instant availability of any volume of hot water, automatic adjustment, space saving, and a noise elimination feature which allows water and steam to mix quietly. Specifications for seven sizes of heaters are given for both direct and accumulator applications.

HPAC 132—STUD WELDING—Eleven different construction applications of stud welding are illustrated in a new four page folder issued by Nelson Stud Welding Div., Morton Gregory Corp., Lorain, Ohio. Uses shown include installation of panels, insulation, electrical equipment, etc.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agents wanted

ATTENTION MANUFACTURERS REPRESENTATIVES: Rapidly expanding ventilator manufacturer has limited territory available. If you contact Heating and Ventilating distributors, electrical distributors and contractors or similar closely allied lines it you have established, active outlets our line of exhausters present real opportunity. Units embody unique, distinctive trade-getting features definitely out of keen competition class. If you have consistent proven accomplishment record, your application will be welcomed. Address Key #872-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

JOBBERS AND REPRESENTATIVES: If you are well established and have many contacts in the heating, plumbing and air conditioning fields, here's an opportunity to get in on the ground floor with a new tool that really promises big material and labor savings to its users. Exclusive territory basis. Write for further details . . . and tell us about yourself. Dept. CA. The Knuth Engineering Co., 2645 N. St. Louis Ave., Chicago 47, Ill.

MANUFACTURER'S REPRESENTATIVES wanted—Heating and Air Conditioning manufacturer, with a complete line, has territories open in Western and Southern States. Prices competitive. Must have established dealer and contractor trade. Please submit full details and personal interview will be arranged. Address Key #871-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

Agents to represent well established heating specialty. Several good territories open. Give full details outlining territory now covered. Liberal commission. Address Key #873-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

lines wanted

Manufacturers Agents established 1933 competent Engineers; Members ASHVE desire line of Gas Heating Equipment. Located in Middle Tennessee. Thorough coverage. Address Key #869-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

situations open

ESTIMATOR: Capable of running department with minimum of 15 years' contracting experience, estimating heating, ventilating, power and air conditioning work. State salary and experience. Replies confidential. Address Key #866-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

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MECHANICAL ENGINEER, age 38, seven years' air conditioning, refrigeration experience specializing self-contained air conditioners; four years' factory, sales, general management experience. Desire responsible position with manufacturer of room air conditioners in planning, sales, promotional capacity. Address Key #870-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

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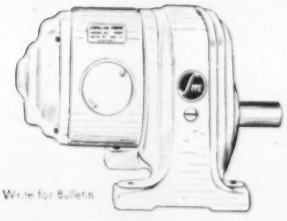

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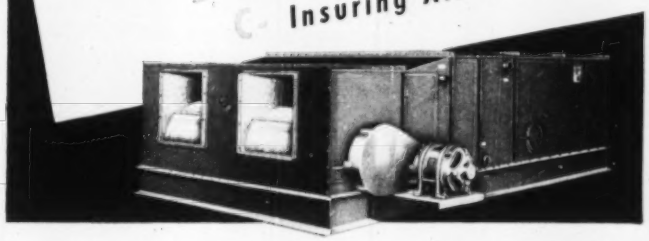
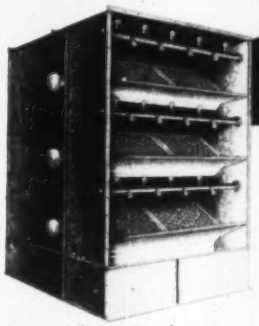
B- Controlling Humidity
C- Insuring Air Cleanliness



Use Clarage Capillary Air Conditioners where *maximum air cleanliness plus accurate control of temperature and humidity* are vital to production, uniformity of product, health or safety.

These Capillary Conditioners are completely assembled units, including a capillary cleaning section, pump, heating coils, fans, drive and motor. Built in seven sizes — 1,800 to 20,000 cubic feet of air per minute, either vertical or horizontal units.

There are excellent reasons for preferring this modern equipment: (1) *Inexpensive to install* — no costly building alterations required; (2) *Everything in one "package"* — no parts to assemble; (3) *Proper performance* assured by factory tests; (4) *Low first and operating costs* — the result of shrewd, advanced engineering.



CAPILLARY AIR WASHERS
4,400 to 132,000 CFM

Clarage Capillary Air Washers are widely used where you need air cleanliness only (temperature and humidity control not desired), or they may serve as the cleaning units in complete air conditioning central systems. Built in 5 height and 11 width sizes.

All Clarage equipment is HEAVY-DUTY; *fully equal to severest industrial requirements.*

We Also Make: Complete Line of Industrial Fans . . . Unit Heaters . . . Air Conditioning Equipment . . . Mechanical Draft Apparatus

CLARAGE FAN COMPANY - Kalamazoo, Michigan

CLARAGE
—HEADQUARTERS for Air Handling and Conditioning Equipment

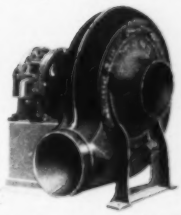
SEE OUR CATALOG IN SWEET'S

It pays to direct fan inquiries our way . . . phone Clarage office in your city, or write us at Kalamazoo.

Application Engineering Offices in All Principal Cities

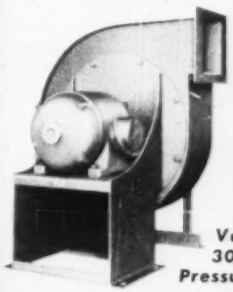
Capacities to 4000 CFM

Pressures to 20"



1 THREE Economy Answers to Industrial Air Handling Problems

TYPE CI EXHAUSTERS are built to the *same exacting standards* as the largest Clarage equipment; *heavy-duty* in every sense of the word! Widely used for removing excess heat, smoke, odors from manufacturing operations . . . in pneumatic conveying . . . supplying air to oil burners, as over-fire fans, etc. Regularly furnished with corrosion-resisting cast iron housings, or in any special construction your special needs demand.

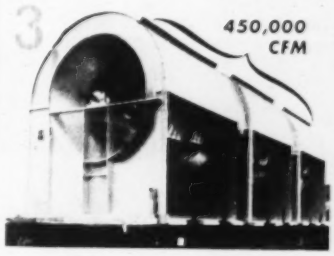


2 Type O Blowers

Volumes to 30,000 CFM
Pressures to 35"

For *higher pressure, larger capacity applications* . . . supplying air to cupolas, industrial gas and oil burners, etc. Fan housings and wheels of heavy steel plate "take in stride" toughest operating conditions. Clarage Type O blowers are built in 19 sizes, operate at speeds *most economical* for direct motor or turbine drive.

3 450,000 CFM



CLARAGE BUILDS equipment *big enough for ANY air handling requirement.* Example: these three Type W Fans recently shipped to a steel plant, and now installed in a large building where gas engines generate electricity. They dilute escaping toxic gas fumes, thus providing safe air for workers. Each fan delivers 150,000 cubic feet of air per minute; must operate continuously. Their *heavy-duty* qualities insure uninterrupted service on this essential job.

CLARAGE FAN COMPANY, Kalamazoo, Mich.

Low water cut-offs for hot water heating boilers was YOUR idea; not ours . . .

It's funny how you can keep walking along a beaten path, thinking you're wide awake, but actually missing something that's right in front of your face.

We were doing just that—going along the beaten path of low water cut-offs for steam boilers when we suddenly awoke to the fact that many contractors and engineers were installing low water cut-offs on hot water heating boilers . . . and for particularly sound reasons.

What were the reasons? This question was put up to our engineering department recently by a Seattle contractor and they responded with two pages of facts (available to anyone interested) but for practical purposes they might as well have said:

There are just about as many reasons for losing the water in a hot water boiler as in a steam boiler . . . loss of connected load, runaway firing, prolonged discharge of a relief valve, or just plain leakage in the system. This being the case, a water level control is just as essential to a hot water boiler as to a steam boiler.

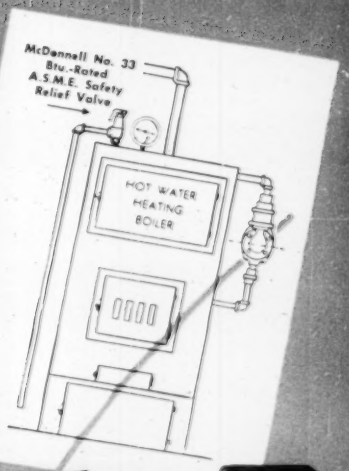
We first recognized this when we found a number of heating engineers using our No. 150 cut-off on large hot water jobs. However, we really sat up and took notice when we found a contractor preparing to use a large number of our No. 67 Low Water Cut-offs on hot water jobs. This wouldn't do at all because the No. 67 is designed for a maximum of 20 lbs. whereas the usual maximum on hot water heating boilers is, as you know, ten pounds higher than this.

That is why we developed the No. 63 Low Water Cut-off illustrated here. The No. 150 (designed for 150 lbs. maximum) is of more expensive construction than is needed for low pressure hot water boilers and the No. 67 is not designed for the higher allowable pressures of the hot water boiler. Hence the No. 63, for pressures up to 50 lbs., designed specifically for hot water systems. Into it has gone the best of all we have learned in "Doing One Thing Well". Ask for bulletin containing complete facts and installation diagrams.

McDONNELL & MILLER, INC.
3500 N. Spaulding Ave., Chicago 18, Illinois

Doing One Thing Well

Note new address



Specifically designed for hot water heating boilers

The No. 63 will dependably break the circuit to the burner whenever the water level falls below a safe level. Designed for a maximum pressure of 50 lbs., it is the ideal low water cut-off for the hot water boiler. All operating parts are isolated from the heat of the float chamber. Heavy duty bellows eliminates packing. Switch is dependable McDonnell snap-action type; A.C., ¾ hp. 110-220V.; D.C., 125 V.A. 115 V. Underwriters' approved. A typical hook up is shown above.

Your Jobber Stocks Them

McDONNELL

Boiler Water Level Controls